EDITORIAL

THE heavy burden now being carried by scientists all over the world, and the increasing pressure which will be experienced in the immediate future, is underlining the fact that, every day, we are reaching limits imposed not by technology as such, but by the human element.

There are just so many hours per day in which a man can work, and just so much effort he can expend without exhaustion.

To keep pace with the expansion of our activities, there is one thing above all others which we must do, and that is to save time.

In bygone centuries the Egyptians built the pyramids, quite sizable projects even today.

They built them mainly through the work of huge armies of labourers, who had the best part of a lifetime at their disposal.

Today, it is doubtful whether anyone would commence a project which would take so long to complete. The builder would have such an array of mechanised might at his command that he could nominate his own target.

More and more, electronics is being used to save time.

In the field of calculation it has speeded up work so much that it can produce answers too difficult to reach by any other method.

As the provider of control mechanisms to order the operations of machinery, it has reached such a stage that even the processes of logical thought can be simulated to quite an extensive degree.

Even so, the field of electronic control has not even been fully explored. Every day some enterprising firm comes up with a new device intended to carry out routine operations in the utmost detail, thus leaving still more free time for the man himself to direct and decide.

The thing which made the earth satellites possible, their design, their ascent to the orbit, the stream of information which comes from them, and the rapid translation of this information into a dozen different scientific fields was all made possible by electronics.

Mere human effort could never have done such a thing.

I heartily concur with the pleas that have been made by professors and scientific leaders in recent weeks for more technical training and qualified engineers. The truth is that, before very long, only people with an expanded technical knowledge will be able to exist happily in a progressive community.

The miracles of yesterday are becoming the commonplaces of today. And if it is the engineer who will supply most of the tools of the new era, it is the electronic scientist who will produce the means to guide and direct them. Through their achievements, the wonders of today will become the trifles of tomorrow.

John Moyle

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RADIO ★★ TELEVISION AND HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION HOBBIES AND POPULAR SCIENCE

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Vol. 19 No. 9

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OUR COVER PICTURE

.—The nine back-silvered mirrors which block the sun's rays and reflect them to the target mirror 32 feet above. See story on page 3.

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SOLAR 6,000 DEGREE FURNACE

HOT-SPOT FOR RESEARCH

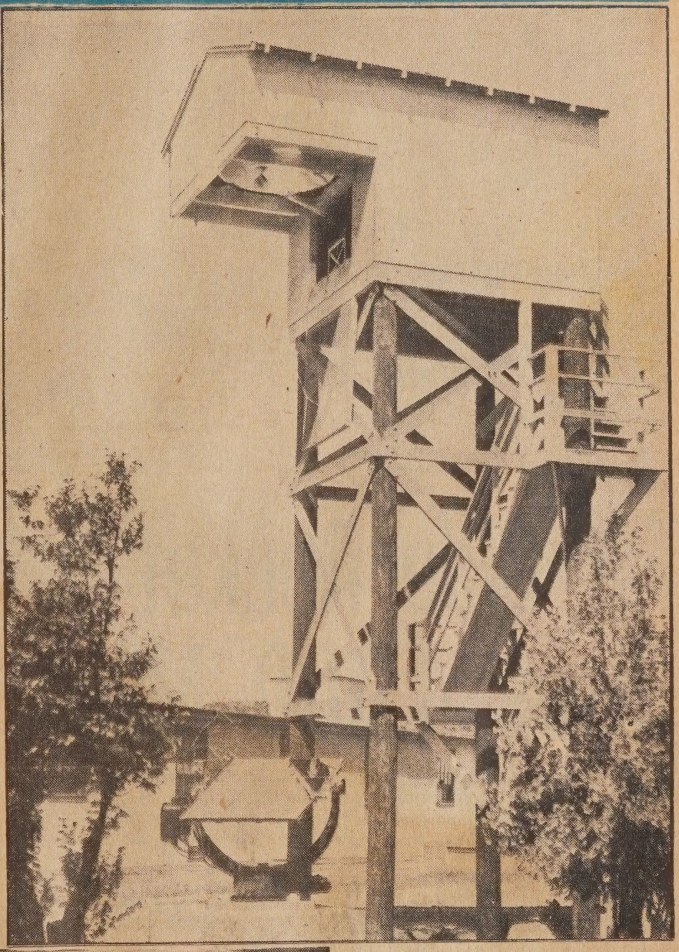
In localities where the sun shines powerfully and often, it is possible to make use of its great heat for many purposes, and much work is being done today to harness this source of free power. Experiments by the Stanford Research Institute have developed a potent solar furnace generating heats up to 6000 deg. F.

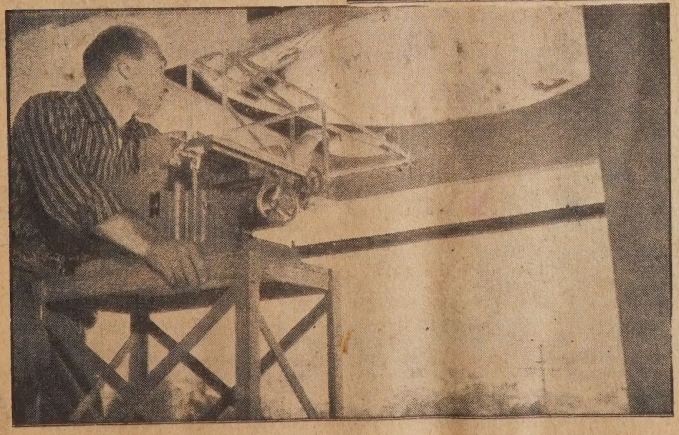
THIRTY feet above the S.R.I. grounds a 3-inch hot-spot of concentrated sunlight is providing up to 6,000 degrees F. of solar heat to assist in various research tasks. It is the focal point of a new solar furnace which will enable the institute staff to conduct certain experiments not possible with other heat sources.

Like other solar furnaces, the facility is not really a furnace but an optical system by which solar radiations are concentrated in a small area. The system consists primarily of two mirrors, and a target. One mirror, called a heliostat, is flat and moveable, and is mounted near the ground. It reflects the sun's rays upward to a curved stationary mirror that looks downward, focusing the rays to create a hot-spot on a target specimen or crucible about two feet below.

The heliostat is actually a group of nine back-silvered mirrors mounted on a cradle which is turned by a control system at a rate necessary to track the sun. The mirrors are tilted as a unit to deflect the sunlight toward the curved

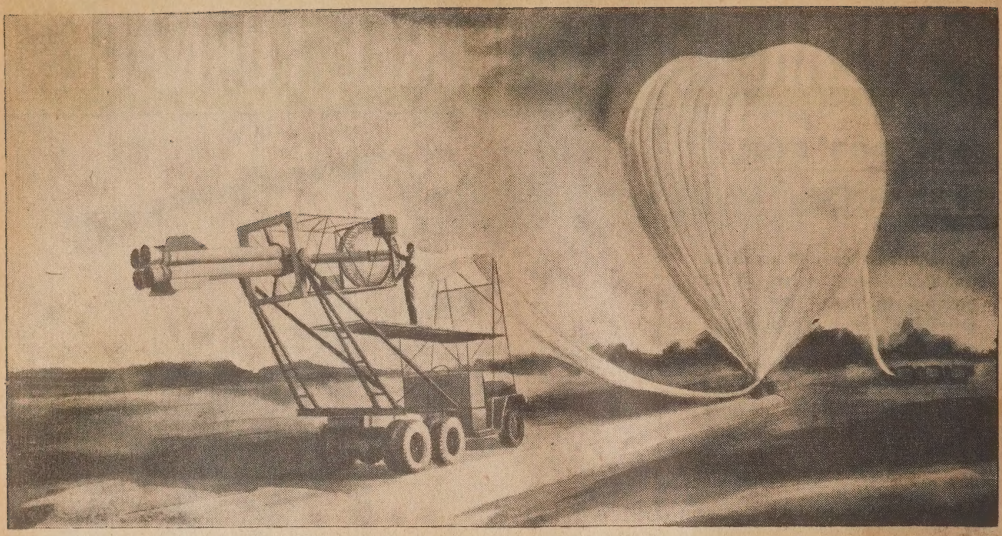
(Continued on page 15)





(Above)—Stanford Research Institute's solar furnace with heliostat on a swivel base at ground level reflecting the sun's rays up to the polished aluminium reflector under the projecting canopy which is concentrating solar heat on the test specimen.

(Left)—Engineer Norman Fisher adjusts the movable shield which covers the target for the furnace. Seen also is the paraboloid or curved, polished aluminium mirror which focuses the sun's rays from the mirrors 32 ft. below.



The Far Side vehicle and associated launcher attached to the aft load ring of the 3,750,000 cubic foot polythylene balloon is being readied for launching. The balloon as inflated has sufficient lift to carry the vehicle and launcher more than 100,000 ft

Far Side Rocket Rises 4,000 Miles

After several unsuccessful attempts, the American research rocket Far Side was successfully launched from Eniwetok Island in the Pacific on October 24. Its full performance figures have not been released, but it rose to a greater height than any man-made vehicle has yet achieved.

A PICTURE of the rocket as it would have appeared after having been fired through its lifting balloon appeared in our November issue, which went to press a few days before the successful launching.

According to Press reports it reached its target height of 4,000 miles with something to spare, although officially this figure has not yet been confirmed.

It seems certain, however, that it easily exceeded the height reached by any previous rocket.

Four initial attempts to fire it were not successful. Experts attribute this not to mechanical or electronic failures but to unfavourable weather conditions which prevented the balloons carrying the rockets from rising to their correct positions.

USE OF BALLOONS

The balloons are used to elevate the rocket beyond the denser part of the earth's atmosphere which would otherwise retard acceleration and consume large amounts of fuel.

The speed of the rocket through this atmosphere would also generate a great heat which could damage or destroy it.

The Far Side rocket bears little resemblance to Sputnik, and its purpose is quite different.

It was not fired into an orbit but straight out into space. It is assumed that when maximum height was reached the rocket head would return to the earth.

ROCKET FLIGHT

The rocket was in flight for an hour and 15 minutes. Its radio signals faded out after eight minutes and returned 75 minutes later. Experts say this time interval indicated that the head of the rocket exceeded 4,000 miles.

Information collected prior to the successful launching of Far Side provides a general description of its construction and the tests which preceded its flight. It is probable that two more will be fired before the termination of the present experiments.

The initial phase of the Far Side project represents the first step in a comprehensive research program aimed at obtaining information regarding the environment at great distances from the earth. Present planning calls for further experiments at even higher altitudes. It is hoped that future weapons systems programs will benefit from the Far Side project.

The four-stage solid-propellant rocket vehicle carried a small highly complex package of scientific instrumentation at a top speed of more than 17,000 m.p.h. The purpose of the rocket is to investigate atmospheric and space phenomena at extremely high altitudes. The design and fabrication of the rocket vehicle and its instrumentation were carried out at the Aeronutronic Los Angeles facilities.

EARLY STUDY

The U.S. Air Force Office of Scientific Research, as a part of its research and development effort, contracted with Aeronutronic Systems, Inc., in November of 1956 to investigate the feasibility of developing a vehicle capable of transporting an instrument package to an altitude of several thousand miles.

As the result of a three-month study a vehicle preliminary design was developed utilising existing rocket engines of known and proved performance, and a comprehensive program of instrumentation to conduct scientific experiments at high altitudes was put under way.

During the course of the feasibility study a technique was developed for launching the missile by means of a platform suspended from a balloon that would carry the vehicle to an initial high altitude of 100,000 feet, thus minimising the problems involved in firing the vehicle through the earth's atmosphere.

The rocket, inserted into the lower end of the balloon transport, blasts upward through the balloon on firing with an initial first stage thrust of 160,000lb.

The feasibility study was completed and submitted to the Air Force Office of Scientific Research in February, 1957. It was then evaluated, and on March 15, 1957, the Air Force awarded a contract

to fabricate the vehicle and to develop the necessary scientific instrumentation. This contract also provided for the flight testing of the vehicle late in 1957.

The vehicle configuration selected was a four-stage solid-propellant rocket. This vehicle, having an overall length of approximately 23ft and a gross weight of 1,900lb, will reach a top speed in excess of 17,000 miles per hour.

The first and second stage rocket engines of the multi-stage vehicle are Recruit rockets developed by the Thiokol Chemical Corporation, Elkton, Maryland. The third and fourth stage rocket engines consist of Arrow II rockets developed by the Grand Central Rocket Company of Mentone, California. The first stage consists of a cluster of four Recruit rocket engines; the second stage, a single Recruit rocket engine; the third stage, four Arrow II rocket engines; and the fourth stage, a single Arrow II rocket engine to which is attached the instrument package. The stages fire consecutively and, after burnout, each separates and is cast free.

ITS MISSION

The mission of the vehicle is accomplished by carrying to the desired altitude scientific instruments and an associated means of transmitting their collected data to ground receiving and recording stations.

The information collected and transmitted to the ground is the measurement of cosmic rays and the earth's magnetic field and the related effect of geomagnetic storms on these measurements.

The size (approximately four inches in diameter and six inches in length), weight (3½lb) and environment in which this instrument package must function demanded the development of a miniaturised radio transmitter capable of sufficient power to transmit the data under difficult flight conditions from extreme distances heretofore never reached. Work in connection with the cosmic ray experiment was performed by Professor S. Fred Singer of the University of Maryland. Dr. Singer is one of the U.S.A.'s leading authorities in the field of upper atmosphere research.

TEST ASCENTS

Aeronutronic selected the Mechanical Division of General Mills, Inc., leading designer and developer of high-altitude balloons, to develop and test a balloon and associated launching platform capable of carrying the multi-stage vehicle to an altitude of approximately 100,000ft. The balloon developed by General Mills was tested on June 28 at the General Mills flight test centre near New Brighton, Minnesota.

During the test the balloon carried a dummy vehicle with associated launching platform, weighing more than 2,300lb, to an altitude in excess of 104,000ft.

At these tests, a number of "first" in ballooning were achieved. The balloon, which was more than 200ft in diameter,

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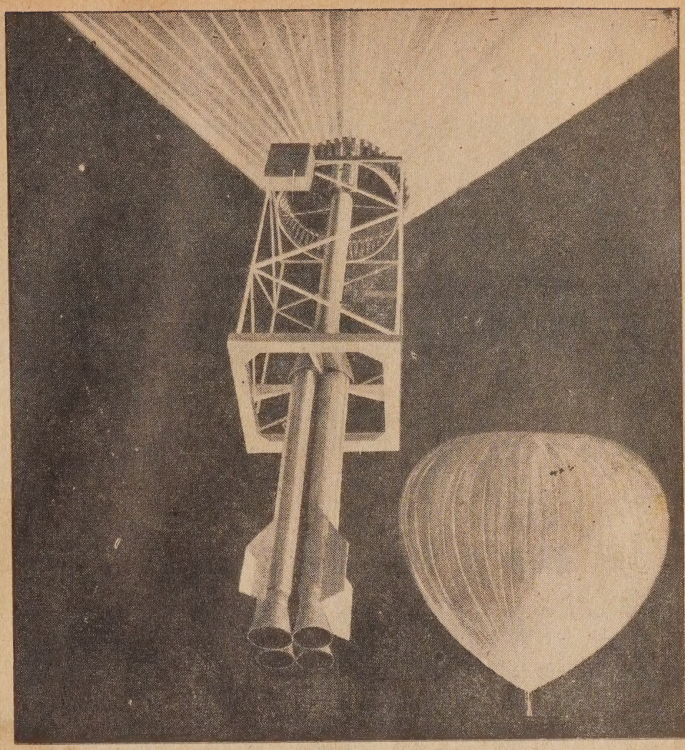
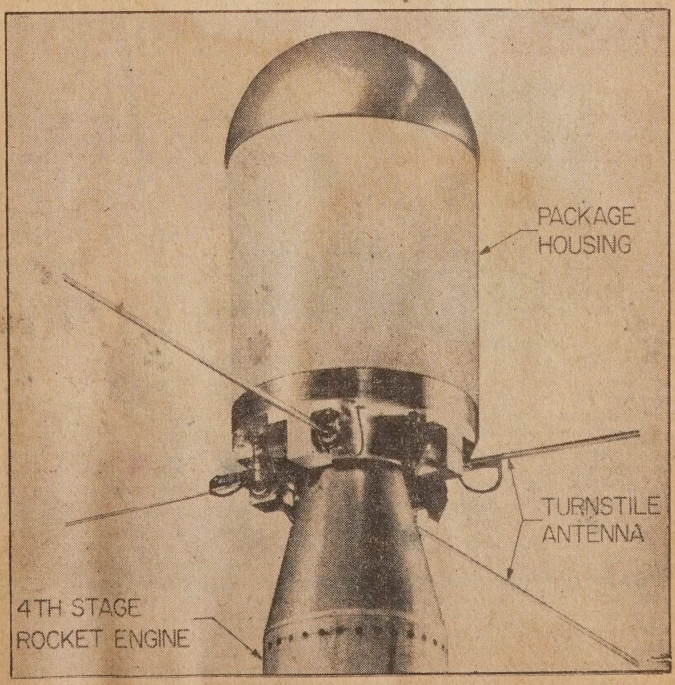


Artist's impression of the vehicle and launcher at altitude, showing the balloon fully inflated to its maximum diameter of 200 ft. The vehicle is launched vertically through the apex of the balloon. The size and relationship of the balloon and the vehicle are indicated in the full view of the completed assembly.



This is the package containing recording instruments and transmitters. The turnstile antenna is opened out at the end of the burnout period of the last stage, and is shown here in the extended position.

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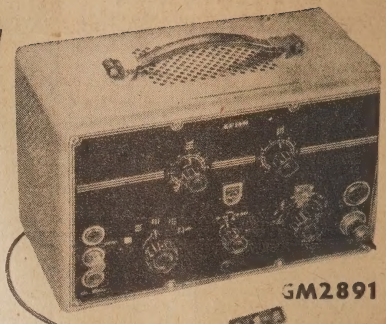

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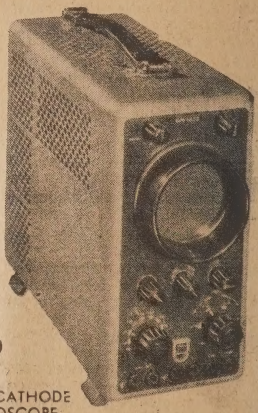

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PG78 57

SPACISTOR-NEW SEMI-CONDUCTOR

Once the wonder of the electronic world, the transistor is now a permanent member of the component family, but in some respects its development has been difficult. Here are details of a new device announced by a transistor pioneer which promises new and valuable improvements.

WITHIN the past few months two new amplifying devices have ap eared in the field where for so many ears de Forest's electron tube ruled one, moving aside a little only in the ast decade to permit the transistor to some of its jobs.

One of the new devices Raytheon's pacistor, looks like a member of the ansistor family.

The other, the Naval Ordinance Lab ratory's solion, is like nothing else in is world. A flat cylindrical cell which ay be less than 2 inches across, divid d or partly divided into two sections nd filled with an electrolyte, it is a oser relative to the old wet cells that sed to operate doorbells than to any ing now used in the electric-electronic eld.

Yet is can measure pressures, flows. ccelerations, and performs other func ons which would otherwise require xpensive, complex and bulky equip ent.

Operating on just under 1 volt, it runs or such long periods of time on an elec ic cell (battery XA-10B) specially con ructed for it as to make even the ansistor look like a current hog.

Neither of these devices has reached he commercial market, and it is still oo early to predict what part they will lay in an electronic world where the ube and transistor have already proved hemselves practical and versatile am lifiers.

U.H.F. DEVICE

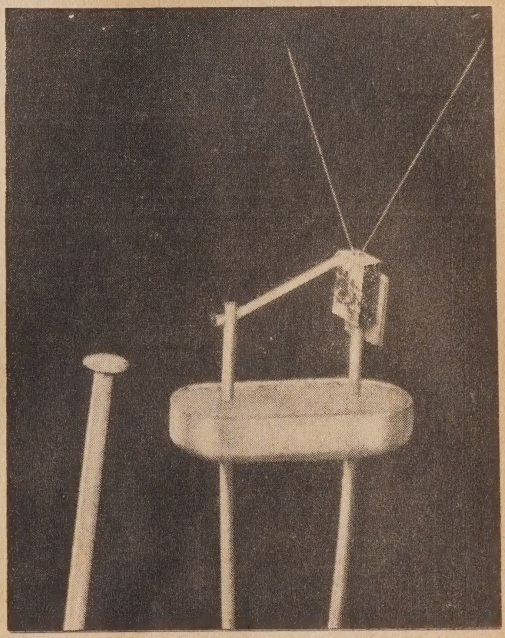
The spacistor is expected to find its ost useful applications in the uhf eld; the solion is limited to a top of 00 cycles at present, but can operate rom there down to DC. It can also e used as a transducer to turn electric nto mechanical energy.

The very name of the spacistor puts in the solid-state amplifier family hose best known member is the tran istor. But this semiconductor device cts in many ways more like a vacuum ube than a transistor. (See Fig. 1.)

The spacistor operates at 100 volts; ransistors are commonly low-voltage de ices. Transistor output and input im edances are low; those of the spacistor re high, even higher than for vacuum ubes. Transistor input capacitances onversely, are high; the spacistor's low r than those of vacuum tubes.

The transistor's most serious limita ion has been frequency. Readers re member when commonly available ones would work well over a little more than he audio range. The frequency limit as been pushed steadily upward since hat time, but is still well below that of acuum tubes.

One reason for the frequency limita ions of the transistor is the slow diffu sion of charge carriers (electrons or



The transistor has three leads; the spacistor, four. They are: base (slanty crossbar); collecto (wire directly under semiconductor block on right); injecto (whisker sized wire on top left) and modulator (whisker sized wire on top right). For comparison, the spac istor is attached to the boatlike-shaped transistor mount

holes) through the base region. The applied voltages are usually low, and little push is applied to the charge carriers. Therefore, they move at a relatively low speed and when faced with rapid alternations of signal current just can't get to their destinations rapidly enough to produce an output exactly mirroring that of the input.

In the language of the scientists, the electric field in which they move doesn't give them enough acceleration.

A vacuum tube—with a drop of usually more than 100 volts between cathode and plate—has a strong field, and electrons are hurried right along in it. The same is true of the spacistor, where 100 volts is applied across the body of the semiconductor, between collector and base in Fig. 2.

The unit is a p-n junction hooked up in reverse bias (the direction that opposes current flow). Thus, there is a sharp potential gradient throughout the spacistor, and we find a heavy space

(Continued on page 119)

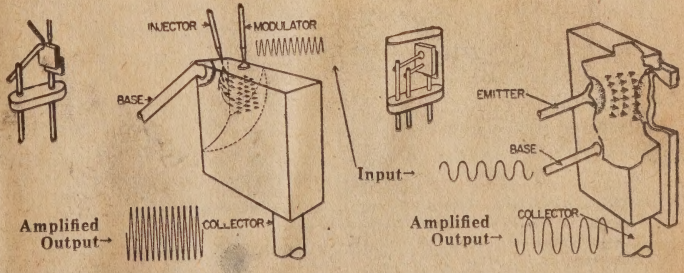
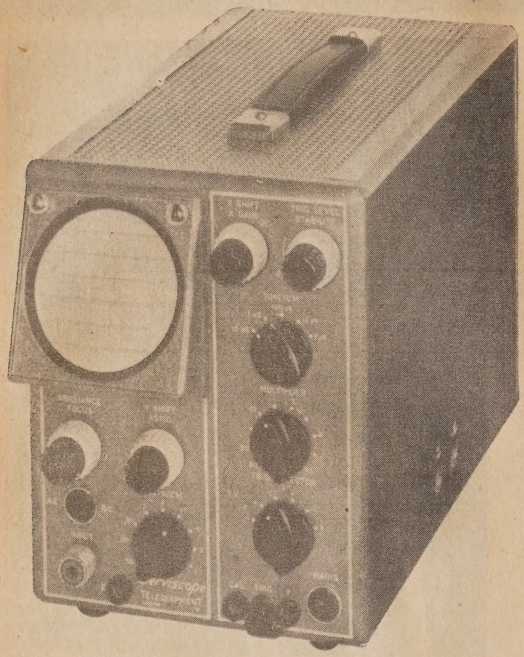


Fig. 1—Two amplifiers compared. Spacistor—High voltage is applied between collector and base in direction to produce strong electric field and practically no current. Electrons injected into this field flow very rapidly to collector. Flow is modulated by signal applied between base and modulator, which acts like vacuum-tube grid. Transistor—Similar but lower voltage is applied between collector and base. Since emitter (in n-p-n transistor) is more negative than base area near it, it injects electrons, which flow to positive collector (at lower speed than in the Spacistor, because of lower collector voltage). Signal to be amplified is applied between base and emitter, current from which increases and decreases as it becomes more or less negative with respect to base. Action is same in p-n-p transistor, with reversal of voltages and current flow.

THE SERVISCOPE



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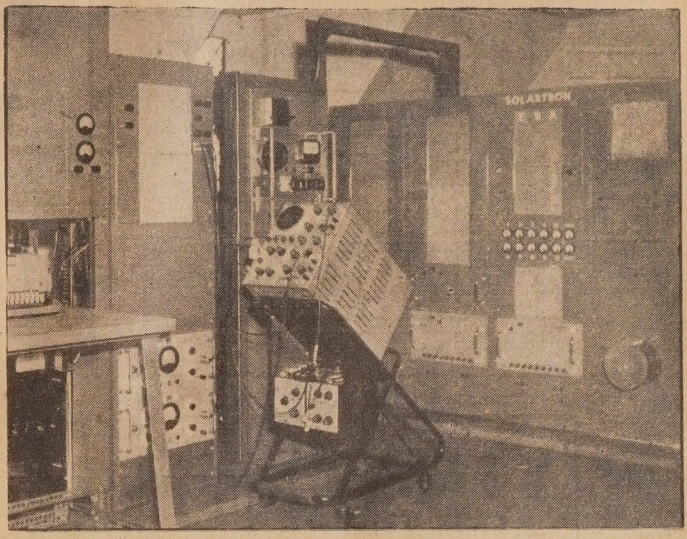


Fig. 1: The pilot production version of the Electronic Reading Automaton

WITH the introduction of computer-controlled machine-tools into the manufacturing shops, problems concerning the input of data to these computers will arise.

Practically all data-controlled machine-tools work on the principle that the programing engineer draws up the machining program by specifying feed-rates, cutter-radius, the co-ordinates of points located around the periphery of the workpiece and also the type of path that the cutter is to follow between these co-ordinates.

All this data, which is a combination of figures and letter-codes, is entered on a standard program-sheet by hand. Information in this form is not suitable for introduction to a computer and, consequently, the visual data presented in terms that human operators can understand—that is figures and alphabets—must be transcribed into suitably coded data that is the operational language of the computer.

This transcription is usually done on some special form of typewriter that produces a punched paper-tape. The punched holes in the paper-tape are the digital-coded equivalent of the written data, and it is from this paper-tape that the information is fed into the computer.

Accuracy in transcription of necessity depends upon the concentration and accuracy of the person carrying out the transcription. Checking systems can be devised, but these need more human operators and consequently detract from the primary virtue of data-control systems that they are intended to reduce the number of human operators to a minimum.

MACHINE READING

A machine that could read any form of typed or printed instruction could render human transcription of the information entirely unnecessary. Solartron Electronic Business Machines Ltd., of England, have now produced an Electronic Reading Automaton (known in short as the Era) to carry out this type of work.

Computing is, broadly, of two kinds. In scientific mathematical calculations only a small amount of information needs to be fed into the computer and a large number of operations take place within the computer before a result is obtained and an answer delivered to the output.

In the business world, the problem is usually the converse of this. A mass of data requires to be fed into the computer on which only simple operations have to be performed before an equivalent mass of information is delivered at the output. For such work, a type-reading unit is almost essential if lengthy transcription is to be avoided, especially if the required rate of input to the computer is high.

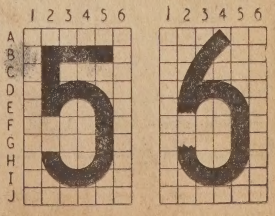
When recognising printed characters the human eye does a far more subtle job than just deciphering clean, plainly printed outlines.

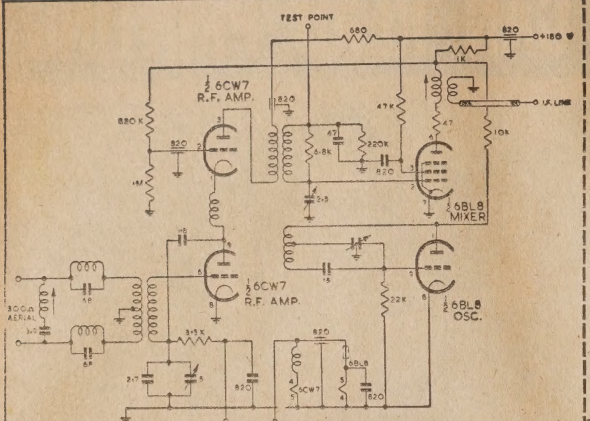
What in effect happens is that a certain amount of reasoning is involved to decide what letter or figure a malformed or overprinted impression is intended to represent.

Most automatic reading-machines made hitherto have not operated consistently because they have been unable to recognise malformed or displaced letters, and if a machine of this type is to have any

Fig. 2: (Left). A typical letter which could be identified by this machine. It is a carbon copy of a cash register character magnified 25 times. From this illustration it can be seen how imperfect is the outline of a carbon copy

Fig. 3: (Right). The manner of identifying a letter is illustrated on the right. Various areas are selected from the grid and according to where a black or white square is detected, this information is correlated with that obtained from other areas and an output generated which specifies what figure is being viewed.





Mullard

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6CW7

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Vh 6.3V
Ih 330ma

CHARACTERISTICS (each section)

Va 90V
Ia 12mA
Vg – 1.5V
gm 6.0mA/V
u 24
* *Rin* 2.0K ohms

* *measured at f = 200 Mc/s with cathode connections pins 7 and 8 strapped.*

The Mullard 6CW7/ECC84 is a double triode specially designed for use as a cascode amplifier in the R.F. stage of television receivers. The first triode is connected as a neutralised grounded cathode amplifier and drives the second triode which is connected in a grounded grid configuration. This arrangement results in a low noise level for the input stage being achieved in the first section, combined with high gain in the second section.

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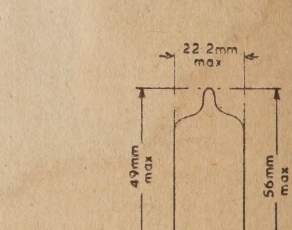

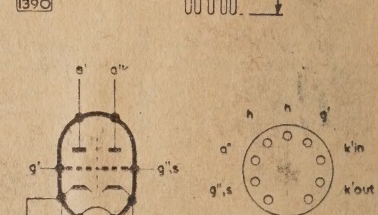

Mullard

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worth in the business world it is very necessary that it should be able to operate from such common business documents as a third typed carbon copy.

The usual troubles associated with the average document are that the printed or typed characters are distorted, smudged, defective and misplaced. Also a large variety of type-faces are used with quirks, serifs and other characteristics that must not be allowed to affect the power of recognition of the reading device.

The Era is an electronic machine of which the present production pilot model can read at the rate of 120 characters per second. The pilot model is built only to read numerals. The reading process can be speeded up to more than 500 characters per second. That is, to read a sheet of double-spaced typed quarto, character by character in two seconds.

SCANNING

The eye of the machine is a scanning device. A raster of vertical lines is produced on the face of the scanner-tube by means of deflection circuits. A photo objective is employed to obtain an image of the character that is being read.

As the scanning-spot moves across the character, the light reflected at any instant is proportional to the luminance of the reflecting surface. A high sensitivity photomultiplier tube converts the reflected light into pulses, which are amplified and are the means by which the character is recognised.

Where severe misalignment of the character occurs, each character is scanned twice, once to correct misalignment and once to read it.

In the first scan the top of the character is observed and the bottom left-hand and right-hand extremities. Each is divided by two, and, in the subsequent scanning operation, the centre of the system is shifted so that it coincides with the centre of the character.

The square in which a character is contained is divided into 100 areas. Each area is recognised as being predominantly white or black and this information is sent and stored in a memory circuit built into the machine.

This information is in binary form that is, each square is identified as being either black or white.

By sampling selected groups of these 100 smaller areas within the main square containing the character, a decision can be made upon what character is presented under the machine reading-head.

The nature of the identification that is made is that if number 12 square and 13, or 32 and 33, is black and number 22 or number 23 is also black, but not number 37 or 38 the character being viewed is a 4.

A simplified diagram to illustrate the working of the system is shown in Fig 3. When identifying the left-hand figure the squares F2 and G2 might be inspected. As both are white and represent a break in the full circle the figure viewed could be either a 5 or a 3. Or it might even be a malformed 6, as shown on the right.

But the local areas being inspected would also indicate that for the left hand figure, squares B2 and B5 are black as well as squares B3 and B4, so the character being examined is a 5 and not a 6. After a character has been identified, the information stores are cleared and the reading-head moves on to the next character. Only one character is identified at a time.

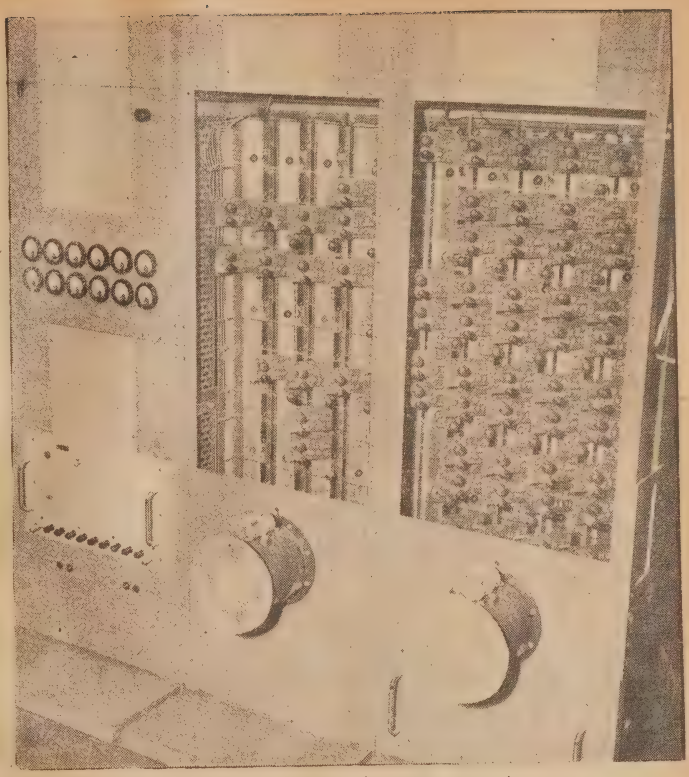

Fig. 4: The memory unit of the machine. Approximately 100 to 1,000 times the amount of information required to identify a perfect letter is obtained from each character.

The amount of information entered in the store is highly redundant, but this is necessary so that a positive identification of any malformed letters can be made. Approximately 100 to 1,000 times the amount of information required to identify a perfect letter is obtained from each character. This level of redundancy ensures that an accurate identification is made. It has been possible to identify letters that have been severely obliterated by overstamping. During tests it has been found that only one malformed letter in 3,000 is incorrectly identified.

The primary output on the pilot model consists of pulses corresponding to the numerals, one per wire, and these can be used for the direct operation of a keyboard or a sorter. For feeding a computer directly, the numerals can be stored in binary form in a temporary store, which is gated serially by clock pulses from the computer.

The Era is quite complex and, electronically, contains almost as much equipment as a computer. The pilot model identifies figures only from 0 to 9, but later models will be built that are capable of identifying the complete alphabet as well. Depending upon the complexity and number of characters it is required to identify, the reading-unit will cost between £20,000 to £50,000.

ELECTRONIC TELEPHONE EXCHANGE

WHILE we are inclined to look upon the automatic telephone exchange as one of those things which is more or less static in its development, engineers are well aware of its limitations. The latest trend is toward elimination of mechanical switches and relays in favour of complete electronic operation.

Although much development work has been done on electronic telephone exchanges, they are not likely to come into widespread use in the Public service for some time. There is no reason, however, why they should not be used extensively for private automatic installations in offices, factories, and so on.

Here they offer the important advantage of small size and absence of moving parts which are often a source of trouble. As an example, Pye Telecommunications have just produced a 10-line private automatic exchange which measures only 20in x 19in x 12in.

The switching is done by Z501 cold cathode valves, with two thermionic valves for shaping the incoming dialling pulses. It has an interesting storage feature by which, if a wanted extension turns out to be engaged, it is automatically rung again as soon as the person there replaces his handset.

The Season's Greetings

to all our Customers

Deck out the Walls with Garlands gay,
And let the kindly laughter play,
Hear the Chimes so sweetly sounding,
Christmas happiness abounding,
All that's good and true be thine,
At this merry festive time.

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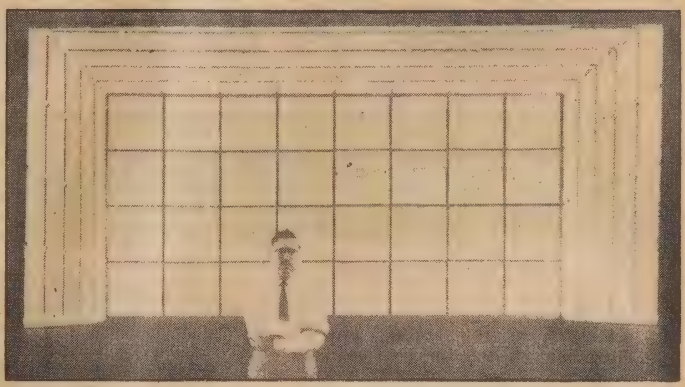
REVOLUTIONARY NEW LIGHTING

USING ELECTRO-LUMINESCENCE

A new approach to lighting, now in the process of development, may revolutionise the design of our homes and office buildings in the future. Light can be made to come from a diffuse source such as a complete ceiling or wall and its color can be made to change at the turn of a knob in order to suit your taste of the moment.



Panels of an experimental room shown here are illuminated by the new method. The panels are made with zinc sulphic activated with copper and operate at 3,000 c/s with a 400 volt supply.

IMAGINE on a cold winter day being able to bathe our rooms in warm coloured light, while at the turn of a knob the same light source giving forth a cool blue on hot summer days. No doubt the architects of this and future generations will make the most of such possibilities, but at the moment our scientists are more concerned with developing electroluminescent devices to a high degree of efficiency and convenience.

OPERATING PRINCIPLE

Basically, the method consists of placing a phosphor in an intense alternating electric field, when, provided conditions are right, they will give up some of the absorbed energy as visible light. It was discovered in 1936 by George Destriau, a Frenchman. Destriau placed some zinc sulphide phosphors in an intense alternating field and made them glow. Even with an intense field the light output was very small and it was not until about 1950 that an intensive research program based on the original discovery was able to take the idea a step further.

A brief look at fundamentals may enable us to understand the idea better. Electroluminescence has much in common with other light sources with which we are already familiar. In a fluorescent lamp the gas discharge produces ultra-violet light which excites the phosphor into producing visible light.

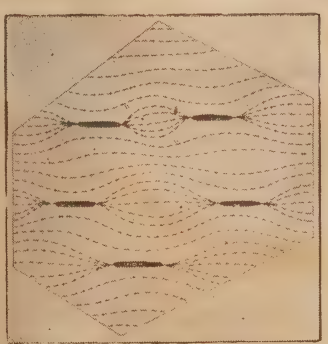
ENERGY SOURCES

In a fluoroscopic screen, X-rays are the source of energy, while in a cathode ray tube a beam of high-speed electrons results in visible light.

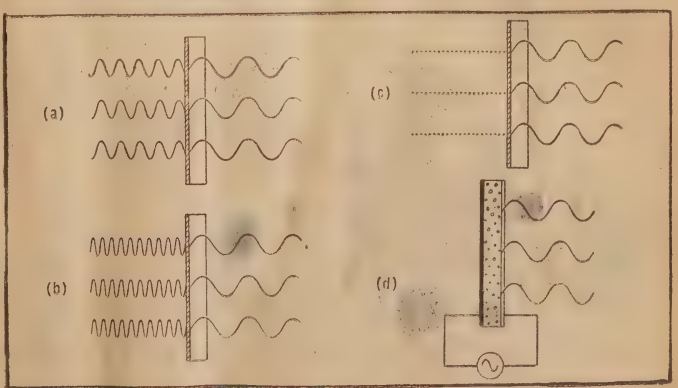
In the case of the electroluminescence we are discussing, the phosphor is embedded in a thin layer of non-conducting material between two conducting layers. The alternating voltage is applied between these outer layers and results in an alternating electric field across the phosphor layer and causes it to emit light.

The revolutionary thing about the idea is that the light sources can be made any desired shape. It can even be made flexible, a curtain, for example.

For an understanding of the behaviour of the phosphors it is necessary to go



At left a crystal of zinc sulphide containing particles of copper sulphide is shown schematically. Because copper sulphide is a good conductor, the particles distort and intensify an electric field (broken lines) around them. At right, crystals of cadmium sulphide are shown enlarged about 100 times. In the original photograph, the needle-like dislocations in the crystal lattices are clearly visible.



In the fluorescent lamp (a) the phosphor converts the short wave length ultra violet into visible light. The fluoroscope (b) converts x-rays to visible light and at (c) high speed electrons in a cathode ray tube are the sourse of light. In the electroluminescent panel (d) the phosphor particles embedded in the middle layer convert alternating current (wave symbol) into light.

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Long play—thin-based tape, giving 50% increased recording time on same spool range.

EMITAPE uses P.V.C. (polyvinyl-chloride) high-tensile film base — the film base which has strength plus stability under varying temperature and humidity conditions.

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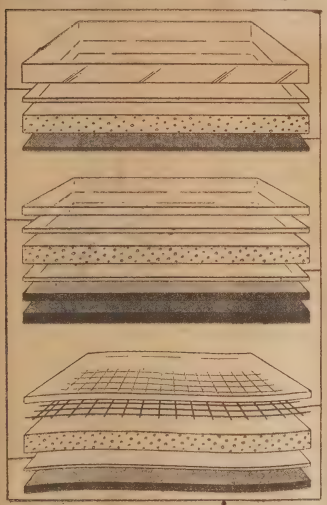
back to fundamental physics of the atom. Atoms are able to jump from their normal state to an excited state by absorbing outside energy. They are then able to return to their original state by giving up the energy in the form of light, heat or other radiations. One of the difficulties is to make the phosphor give up its energy as light rather than as heat, etc. Special impurities are sometimes added in order to achieve the desired results. Much of the research going on is along these lines.

One of the big difficulties with electroluminescence is to get sufficient output. The two main ways are: (1) Simply increase the voltage applied to the conducting surface; or (2) increase the frequency of the alternating voltage. There are practical limits in both directions.

LIMITED BRIGHTNESS

The greatest brightness yet produced was achieved by exciting a green phosphor with a field at 20,000 c/s when 2,500 lumens per square foot of phosphor area were produced. Although brighter than a standard 40-watt fluorescent lamp, the amount of power taken was very great because of the very low efficiency. To quote some figures, a fluorescent lamp will yield about 65 lumens per watt and an ordinary tungsten lamp about 16. The electroluminescent lamp works at 20,000 c/s only about 1 lumen per watt of input power.



Complex panels dissected. Layers of the panel at top are from top to bottom: glass, conducting coating, phosphor particles suspended in plastic and conducting coating. Other panels make use of plastic and wire mesh to achieve different physical characteristics.

At the present time electroluminescent lighting requires alternating current of higher frequency than supplied through the power mains but means of converting the energy to a suitable frequency are becoming more generally available. Transistor-powered devices could be used or a small motor alternator. In large buildings it may be economical to install a special generator to supply the high frequency energy and if the lighting system meant that less ceiling space was required, the overall result could easily save money.

Many new ideas in building will, no doubt, spring from the fact that electroluminescent light sources may take any shape. Doors, walls, stairs or any other element may be used as light sources. Furniture and draperies can also be made to give light because the luminescent sheets can be made as flexible as many types of cloth.

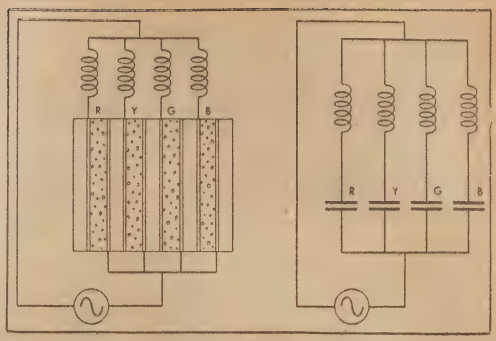
COLOUR RANGE

Colour can be chosen almost as required. Copper introduced into the phosphor gives blue or green while manganese gives light toward the longer wavelength end of the spectrum. By a siutable combination of phosphors the desired range of colours can be achieved by tuning the exciting frequency over a given range.

Electroluminescence may find application when used in conjunction with other ideas which have already been exploited. For example, if we employ a photoconducting layer in conjuction with an electroluminescent layer and apply a voltage across the two in series at the same time focusing an image on the photoconducting layer, the intensity of the light falling on each spot will govern the voltage distribution at that point. The more light that falls on the combination panel, the greater the voltage across the phosphor and hence the greater the light output.

The incident light need not be visible and the new technique could display X-ray pictures many times more brightly than the fluoroscope at present used is capable of doing.

Much more development work remains to be done before you can walk into your neighbourhood electrical store and order components for electroluminescent lighting, but perhaps it will be an everyday thing within a few years.



Multicoloured panel is made by stacking red (R), yellow (Y), green (G), and blue (B) phosphors. Inductors are used to tune in each layer as shown in circuit at right.

A SOLAR 6,000 DEGREE FURNACE

(Continued from Page 3)

polished aluminium mirror, or paraboloid, 32 feet above. The target consists of a mounting plate at the end of a retractable framework. Attached to this framework is a shield that can be swung over the target specimen to shut off the heat.

This design provides maximum efficiency in solar heat concentration consistent with the greatest possible advantage in operation and use. Compared with the type of solar furnace in which the entire apparatus moves to follow the sun across the sky, the design permits the target specimen to remain stationary with the specimen or crucible horizontal and facing upwards. Although it requires two mirrors, the second mirror causes a very small heat loss of 200 to 300 degrees F.

ADVANTAGES

Temperatures of 6,000 degrees F. can be obtained by other means, such as actual flame, electrical resistance, arcs, or electrical induction. The solar furnace offers, however, many advantages over such methods. The radiant energy obtained is a kind of "pure" heat and does not produce contaminants as do other heat sources. Since the heat is concentrated in a very small area, the specimen alone is heated.

The heat concentration of the solar furnace permits the quick attainment of high temperatures and subsequent rapid cooling. As the "hot-spot" is very sharply defined, it is possible to obtain a sharp temperature gradient; that is, an inch away from the centre of the spot, the temperature drops to over 3,000 degrees F.

The new furnace is generally similar in principle to certain furnaces at the Mont Louis Solar Laboratories in the French Pyrenees. The Kennecott Copper Corporation has a somewhat similar facility except that it uses an additional mirror. Specifically, however, the S.R.I. furnace is the only one of its type in operation in the United States.

MANY RESEARCH USES

Work is beginning on a variety of research tasks requiring the kind of high-temperature conditions provided by the new solar furnace. It is particularly useful in the preparation of "super-pure" materials such as single silicon crystals.

Since melting occurs only within the limits of the sharply defined "hot-spot," and thus on the specimen alone, contamination from a crucible is avoided. This advantage is particularly significant for research on transistor materials where extreme purity is important.

Measurement of thermal characteristics and conductivity of materials at high temperatures is easier with the solar furnace. To study the effect of thermal a chilled specimen can be placed on the target plate under the movable shield. By suddenly withdrawing the protecting shield, the ceramic is exposed instantly to the furnace temperature.

Over the air this represents the collapse of a huge, burning building. In fact it is a strawberry box being crushed in the hands of the sound effects man.

Sounds Not Always What They Seem

The art of the sound effects man has progressed a long way since the early days of broadcasting. Indeed it may be assumed that it has progressed from an art to a science for, today, various branches of science have been brought in to assist the sound effects man to produce every sound in nature known and unknown.

by Calvin Walters

THE writer well remembers those early days of broadcasting when radio plays were accompanied by sounds which, although purporting to represent those required by the action, were, more often than not, considerably short of reality.

LIMITS OF MICROPHONES

In those days microphones were not what they are today. They could quite easily convert certain sounds into something entirely different from what was required.

The limited frequency response of microphones and other equipment imposed severe restrictions on the choice of sound equipment, with the result that there was a tendency to "give it away" and merely make noises in the studio which one thought sounded something like the real thing but which were actually far from realistic.

The position was also aggravated by the comparatively primitive equipment used for reception. We call to mind those old receiving sets with transformer-coupled amplifiers feeding into magnetic cone speakers or the dear old "Magnavox" horn-type dynamic speakers. Those who possessed the latter were really in the upper classes of radio receptionists.

My own fortunes were not considerable enough to own one of these. Being classed as an "experimenter," with an appropriate licence, I was one of the privileged few who had access to the "best" through the good offices of agents who were anxious to further their trade by means of recommendations. That was the nearest I ever got to owning one of those "super" speakers. But I always had to give them back.

It was little wonder, then, that the sound effects man was up against it. Snapping matches in front of the microphone served for all manner of sounds, such as hitting a ball with a cricket bat, a box on the ears, slap on the face, man walking through brush wood, snapping fingers, closing cupboard door.

A tap on the side of a snare drum served to slam a door, pistol shot, punch on the nose, pulling cork from bottle.

Rubbing two pieces of sandpaper together served for a railway train. Continuous tapping with sticks on a snare drum or the seat of a chair represented a motor car or motor-boat running, or anything else that was considered suitable. Rubbing the snare drum with a wire brush was rushing water. The snare drum was a most useful instrument.

EFFECT ON DRAMA

Gradually, as equipment improved, radio drama took on a new face. Demands were made for something more realistic. It was found that sound effects could establish a lot of things in the minds of the listener, and became to radio plays what scenery is to the stage, whether the scene was inside or out. Whether it was on the ground, up in the air, on a train, boat, or other transport, down a mine shaft, and so on, "atmosphere" was with us.

It was no longer good enough that anyone handy around the studio should make any noise considered appropriate. The sound technician made his debut. His was a highly specialised art.

Today the sound effects technicians comprise a limited group of people with highly specialised training.

Just as scenery is essential to the stage play, so sound effects are essential to the radio play. They enable the listener, through his imagination, to create a mental picture of the scene being produced in the studio.

The psychological effect may be enhanced by the actor's allusion to the sounds during the speaking of his lines. This is often done during the play. It sometimes enables the sound technician to produce an effect with the simplest of equipment such as the rustling of a piece of paper in front of the microphone which will create an illusion of a waterfall, or leaves falling from trees.

FROM A ZEPHYR TO HURRICANE

ARDUOUS WORK

The work of the sound effects technician is very arduous and exacting. It does not merely entail collecting the bits and pieces which may come useful in the studio.

He must operate in close collaboration with the director of the show, closely study the script, and experiment maybe for hours prior to the play in order to assemble the gear which will produce the best results.

To give some idea of the qualifications required of a good S.E. man (sound effects man) following description is given by Waldo Abbot in his book, the "Handbook of Broadcasting."

"The S.E. man should possess a good sense of rhythm and timing. He requires finesse, artistry and good judgment . . . an active imagination and ingenuity is essential. He should be able to memorise his cues which may number 50 or 60. He must be absolutely dependable, for the sound effect must come on time, at just the right level and for just the proper duration . . . he should be resourceful, eager to experiment, know radio engineering and studio technique, appreciate dramatic values and have a workable knowledge of music and rhythm. Added to this he must have a pleasant personality to withstand the rigors of long rehearsals and tired radio directors.

There you see a description of Superman. A pleasant personality in a mad house, for that is what a radio play rehearsal is.

COLLECTION OF JUNK!

In the old days the S.E. man was a junk collector and still remains one to a limited extent. He still collects tin cans, broken cups and saucers, bags of gravel, soda fountain straws, bottles, slabs of concrete, old doors (squeaky door is a real gem), bits of motor cars, roller skates, sandpaper, squeaky chairs, motor tyres and all such manner of junk, for it is remarkable what effects can be obtained with such articles or combination of articles.

Barry Freeman, ABC Sound Effects Operator operates the wind machine—a wooden paddle rubbing over a canvas flap. The ABC took this picture for us.

The greater proportion of sounds used today in radio plays are recorded. These sounds are made from the original and great effort has been made to collect these sounds.

A catalogue of recorded sounds has an unbelievable variety such as cats fighting (also dogs and humans), chopping through river ice, drilling an oil well, milking a cow, snores, laughing, crowds lapping, cheering, booing, etc., elephants trumpeting, babies crying, groaning, screams, cattle noises, trains, cars starting, stopping and squealing brakes, nagging wives, drunken husbands, and so on.

An interesting story concerns a manufacturer who complained that the recorded sounds of groans and screams were made by actors and were not realistic. He suggested that the recording apparatus be taken to the local hospital where he could record the groans and screams of people injured in automobile accidents.

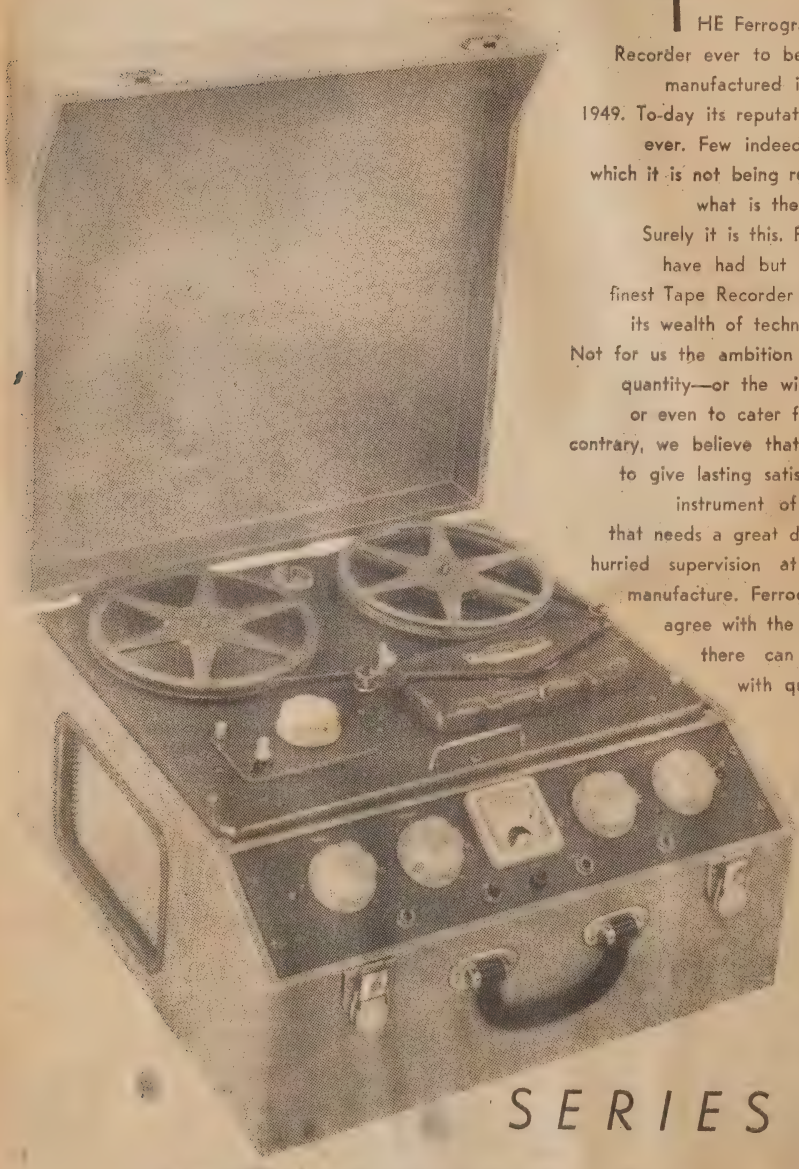
These sound records are carefully classified by the S.E. man and indexed so that he can gain access at a moment's notice.

After studying the script, the S.E. man marks his cues in red circles. He then collects the records with the appropriate sounds and the other odd bits and pieces for the sounds made manually in the studio.

These are arranged in the order in which they are used. Records are played in a manner similar to those in the

The BBC use this water tank to simulate the sound of a rowing boat.

The Incomparable Ferrograph



THE Ferrograph was the first Tape Recorder ever to be designed and wholly manufactured in Britain. That was in 1949. To-day its reputation stands higher than ever. Few indeed are the countries to which it is not being regularly exported. And what is the secret of its success? Surely it is this. From the beginning we have had but one aim: to make the finest Tape Recorder that this country, with its wealth of technical skill, can turn out. Not for us the ambition to make the greatest quantity—or the widest range of types—or even to cater for all pockets. On the contrary, we believe that for a Tape Recorder to give lasting satisfaction it must be an instrument of the utmost precision that needs a great deal of critical and unhurried supervision at every stage of its manufacture. Ferrograph users appear to agree with the simple philosophy that there can be no compromise with quality • • •

The successor to Series 2A has the following improvements:
New clock-type Turns Indicator.
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DICK TURPIN RIDES THE HIGHWAY

Another ABC picture of Des Turner, Senior Sound Effects Officer, simulating the sound of horses hooves on ground. The fishing reel in the foreground sounds like a winding clock, and at the right are a bell and a buzzer.

home, namely, on a turntable and pick-up, but there is a difference.

The equipment used in the studio is a complicated piece of mechanism called a "sound truck," Console and other names It consists of an assembly of turntables (three or more) with pick ups so arranged that each pickup can be swung on to an adjacent turntable Thus, any record can have two pick ups playing upon it at the same time.

This enables the operator to, let us say, sustain a recorded sound beyond the playing time of the record. The one pickup is used until the sound begins to run out at the end of the record The adjacent pickup is then placed on the record and the process repeated if necessary.

This method obviates the risk of a break occurring in the sound, but it requires split-second timing with the aid of a "cross fade."

P.U. CONTROL

This is a volume control which is provided on each pickup. When the first pickup is near the end of the record the second pickup is lowered on to the beginning of the record and the volume turned up at exactly the same moment as the volume control on the first pick up is turned off.

Individual pick-ups are often fitted with their own "high" and "low" note controls as a further aid to the production of correct sound effects.

It has been found that a recorded gun shot sounds correct only when the "lows" and "highs" are present, but the ricochet is best with the "highs" emphasised.

Sometimes a wanted effect is found amidst the multitude of sounds recorded on any one side of a record. When this sound is wanted, "cuing in" must be resorted to. This means that the S.E. man must mark the record at the precise spot where the wanted sound is to be found. An instrument called a "preset" indicator is also used to find the exact groove required at the precise moment.

ARTIFICIAL THUNDER

Referring to the gunshot sound and the use of the "highs" and "lows," the same applies to the sound of thunder. To get a realistic effect of this phenomenon the "highs" must be emphasised for the initial clap and the "lows" emphasised for the drawn-out rumble which terminates the episode.

A scene has often been witnessed or listened to where a gunshot is sounded where the bullet ricochets from a stone wall or side of a house. There is often a thunderstorm raging at the time the battle is on. The S.E. man's task would be as follows:

SIMULTANEOUS SOUNDS

He has a record of a gunshot and another of a thunderclap. He must turn up the "low" control for the gunshot then instantly turn up the "high" control for the ricochet. At the same time he must turn up the "high" control for the initial thunder clap and instantly turn up the "low" control for the rumble. This is the converse of the gunshot.

You can see, then, that the S.E. man must be a very busy fellow with all his wits about him. One can imagine the effect of giving us the gunshot for the thunderclap and the thunderclap for the gunshot.

Very often, of course, there are many sounds which must be given at the same time. A motor car on a country road with the birds singing, a tractor going in a nearby field, people talking, others walking, an aeroplane overhead, and so on. It can be seen that in such circumstances the S.E. man must have assistance, and even then it is an amazing feat of concentration and timing on the part of each to bring in all the sound effects at the right time.

There are, however, many sounds which can only be produced manually to get the greatest effects. These are the sounds which the S.E. Man creates with his bits and pieces of junk or made-up apparatus.

One of the most interesting contrivances is the echo chamber. It is obviously impossible to get a record of say a shout of a particular word uttered in a large room or courtyard or canyon. The studio is designed to damp out such echoes and when one is wanted it has to be manufactured.

The best type of echo-chamber is a long passage about three feet wide, six feet high and thirty feet long. It is sound-proofed against outside sounds and is lined with a smooth reflecting material. It is closed at each end and is provided with a microphone at one end and a loudspeaker at the other.

When in use, the engineer in the control-room plugs in the appropriate connections and the sequence is as follows.

ECHO CHAMBER

The sound is sent from the studio microphone through an amplifier and on to the loudspeaker at one end of the echo-chamber. It reverberates from the reflective walls and floors of the narrow passage as it travels along, and is finally picked up by the microphone at the other end of the chamber. This sends it back to the control-room panel, where it is sent out through the usual broadcast channel.

The action of the echo-chamber adds a delay or time lag to the original sound, with the result that a portion of the original sound goes straight out to the listener and is followed a fraction of a second later by the remaining portion in the form of an echo.

Quite a few electronic devices have been devised to aid the S.E. Man in his work. One of the most important of these is a filter device which has the effect of filtering out any sound frequency from the original sound.

Many of us have wondered how that

(Continued on page 119)

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Technical Review

NEW AUTOMATIC VALVE TESTER USES CARD SYSTEM

With the multiplicity of valve types, tester design now poses many problems. This latest American version, detailed in an excerpt from Radio-Electronics, shows how one manufacturer has brought forward an entirely new approach

AUTOMATION has reached the tube-tester field in the form of an instrument which checks all important aspects of a vacuum tube under actual service conditions and literally does it in one-two-three fashion.

Operation One consists of plugging a tube into a socket and placing a card in a slot. This immediately tests the tube for shorts, leakage and grid emission. Pushing a button marked 2 tests the transconductance, and button 3 tests the tube for gas.

The new device is Hickok's Cardmatic Tube Testing Machine and its construction permits anyone who can read the words GOOD and REPLACE to test tubes with laboratory accuracy.

The outstanding mechanical feature of the tester is a multiple-contact sandwich switch. This consists of an assembly of plastic panels about the size of a postcard. The bottom part of the unit contains over 170 specially designed switch-contact units.

These units are made up of plungers resembling copper nails which, when pushed downward through copper sleeves, enter and make contact with other sleeves below (See Fig. 1.)

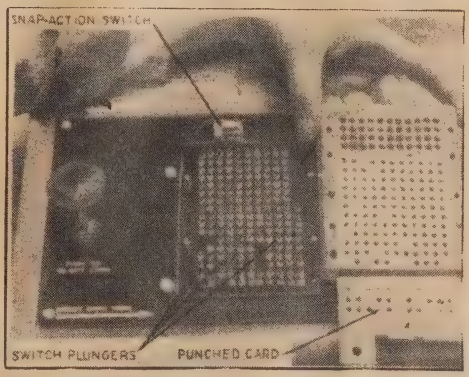
USE OF THE CARD

In operation, a card corresponding to the tube type to be tested is put in a slot in the sandwich and pushed until it touches a snap-action switch at the rear of the unit (Fig. 2). This triggers an electromagnet inside the instrument case, which pulls the sandwich assembly down on the copper switch plungers.

If there is a hole in the card over any given switch plunger, it will not be pushed through to the bottom sleeve and the switch remains open. In positions where the card is not punched, it bears down on the switch plunger and closes the circuit.

A notch cut in the top of the card coincides with the plunger for the sensitive snap-action switch if the card is inserted upside down. This safeguard prevents the test from being made until the card is right side up.

When a test is completed, the card is released by pressing a large button which mechanically restores the sandwich assembly to normal, lifting it upward. This action releases the card so that it can be withdrawn. It also pulls upward on the switch plungers of all.



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(Left) Fig 1: The card switch—heart of the Automatic Tester. A punched card determines which of the plungers will make contact when the "sandwich" closes

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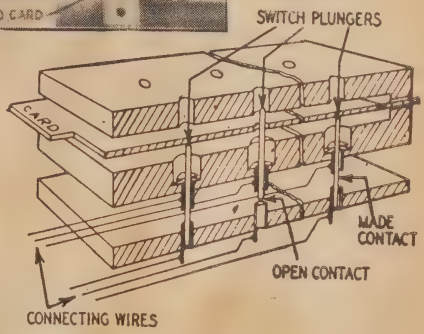

(Right) Fig 2: Inside the switch housing. Each plunger is actually a separate switch.

made contacts, causing them to withdraw from the bottom sleeve and again become open.

Once a card and tube have been placed in the machine, operation is almost completely automatic. The first operation, that of testing for inter electrode shorts, is done at once without even pushing a button.

A voltage divider places a voltage gradient across all electrodes in the tube. The gradient is such that five neon indicators which peer out from under a tiny hood remain dark if no shorts exist. If a resistance path is present between tube elements, it upsets the voltage distribution. The lamps flash for a high or glow steadily for a low-resistance path in the tube.

Grid emission, a highly objectionable defect not revealed by some tube testers, shows up on the short test because of the way the D.C. neon lamp supply is polarised when connected to the tube.

Heater-cathode leakage is indicated by the first of three scales on the meter. A definite reject point is indicated (by the words GOOD and REPLACE) but this point may be as low as 10 microamperes for some tubes. The holes in the card determine the test placed on the tube.

An aim in the instrument's design is to overcome the principal objection that many radio men have to all tube testers, that "the best test of any tube is how it acts in the circuit for which it was designed."

A 6 x 4 is usable with a 150-ua leakage (at 100 volts) between heater and cathode, while an IF amplifier such as the 6AU6 cannot tolerate a leakage of over 10 ua. The reject points in all Cardmatic tests are determined by using standard military specifications as a guide.

In all cases, the tester automatically applies conditions which simulate those encountered in actual service.

For instance, diodes may be classed as falling into at least six basic operational groups. These include full-wave high-voltage group (5U4); half-wave low-

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voltage group (35Z5); TV dampers (6W4); TV high-voltage diodes (1B3); high-perveance detectors (6AL5); and low-perveance diodes (6AV6).

Each of these groups is given tests common to the group as well as specific tests called for by the individual tube type. Thus, a 5U4 and a 6X4 will both be tested in a circuit using a high-voltage centre-tapped AC winding and a load resistance with filter capacitor. The 5U4 will be required to deliver its handbook rating of 200 m.a., and the 6X4, 70 m.a., or show as REPLACE.

Television damper tubes such as the 6W4 must withstand high inverse voltages in service, therefore the Cardmatic applies a set of conditions which will test this feaure. A low voltage applied to the plate of such a tube readily tests its emission characteristic and this may be sufficient for some classes of service. For damper service, however, 1,200 inverse volts are applied because this is what the tube might be expected to withstand in actual service.

Sometimes, in testing diodes, gassy tubes may arc, causing the meter to slam full-scale deflection. If this happens, a protective relay trips, turning the tester off before any harm can be done.

Actual laboratory tests with defective tubes have shown this machine balks and refuses to test gassy tubes.

TRIODES

Pentodes and triodes may be operated in one of two basic modes—fixed bias and self bias.

A fixed-bias test is a stringent one to apply if a tube is intended for self-bias operation. This is because self-bias provides a kind of self regulating effect for the tube when in operation.

Thus, a tube under self-bias conditions will show a mutual conductance rating closer to the published value, while fixed bias would indicate REPLACE long before the tube would fail otherwise.

The tester selects the correct mode before applying a mutual-conductance test to a tube. However, while mutual conductance is perhaps the most important measurement that can be made on most tubes, some tubes in certain applications require an additional test.

Tubes which contain two units in one envelope, or extra elements such as two control grids, are tested with two or more cards—one for each tube function.

The Cardmatic includes a cathode-activity of Life Test and a provision for testing regulator tubes.

LIFE TEST

The Life Test is an approximation, but it is one used with good results by large tube users such as the telephone company.

This feature is operated by a spring-loaded switch which decreases the heater voltage by 10 per cent. If a tube has considerable reserve life left, the mutual conductance does not change appreciably.

Tubes in which emission drops as much as 25 per cent for a 10 per cent heater-voltage reduction may be considered as being near the end of their useful life.

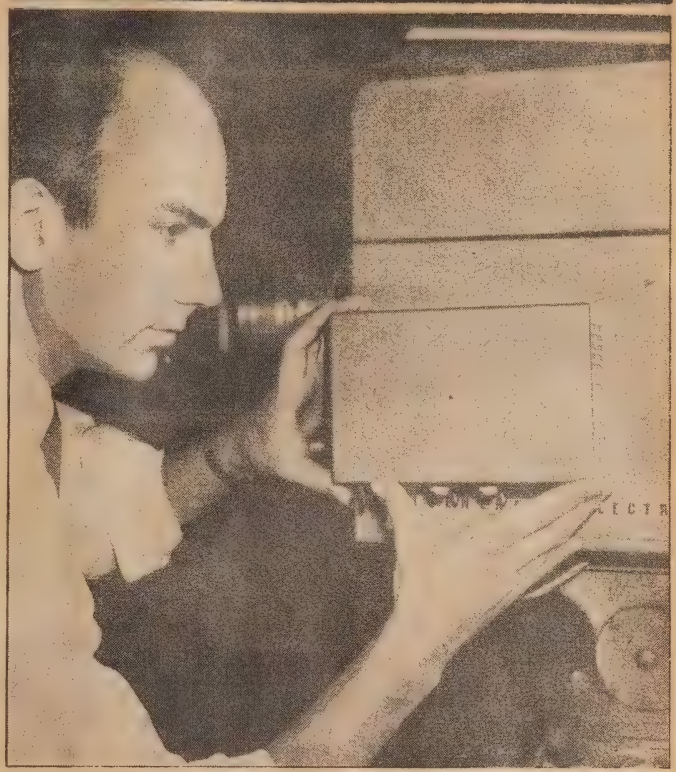
The Hickok automatic tube testers do not use a calibration for line voltage. Instead, the critical electrode voltages applied to the tube are obtained from regulated power supplies, making line-voltage calibration unnecessary.

But perhaps the most outstanding feature of the new machines is the means by which they can be made to test themselves. Normally a tube tester must be regarded as a sort of a standard; tubes are accepted or rejected on the basis of a reading obtained on the meter of such a tester. Yet the tester itself can lose its calibration or otherwise get out of order, and the user may be none the wiser until he has thrown away a lot of good tubes.

The conventional tube tester is checked by specially calibrated tubes—tubes which have been tested by a laboratory. These tubes are retested on a tube checker of doubtful accuracy to see if the same readings are obtained as were produced in the laboratory.

None of this is necessary with the Cardmatic. Each instrument comes supplied with a set of special test cards. To use them, you have only to remove a small panel on the side of the instrument, which exposes a set of potentiometer shafts. Each card is placed in the slot assembly and the corresponding potentiometer adjusted to a specified reading on the meter scale. The card itself tells the amount of deflection which should be obtained on the meter.

EXTENDING PICTURE TUBE LIFE



AN electronic device about the size of a cigar box developed by G. E. of America, which hooks on the outside of a television camera, is expected to double life of costly picture originating tubes.

The device prevents "burn-in and sticking of images" on image orthicon tubes. These tubes are the heart of modern TV cameras. They pick up images and translate them to electronic signals for transmission to television receivers.

At present the new "tube saver" can be used on seven out of eight TV cameras now in service throughout the broadcast industry. In the near future, it will be adaptable to all TV cameras.

A common ailment of TV camera image-orthicon tubes is burn-in and sticking of images — an imprint on the tube which distorts pictures being transmitted to home receivers.

When this happens the tubes must be discarded which can become quite expensive for TV stations.

With the "tube saver," tubes are expected to last twice as long. Principle of the new electronic "tube saver" is an electronic deflecting system used to move or "wobble" the TV image inside the tube. Thus "burn in or sticking" is avoided. To offset the wobble, a scanning beam inside the tube follows and automatically compensates the wobble, causing the transmitted picture to appear as a normal stationary image on home TV receivers.

The complete unit comprises about 50 small parts including six capacitors, a synchronous resolver and a drive motor.

By extending the life of tubes, the new device is expected to allow transmission of clearer pictures, without carry over or distortion from previous scenes.

It is also expected to improve studio camera techniques. In most "live" shows at least two cameras are used. While one is transmitting, the other is focused on the scene to follow and is "alive" but not on air. Prior to development of the new "tube saver," cameraman number two was required to keep moving his camera to prevent "burn-in or stickiness" of the scene to be televised.

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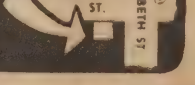

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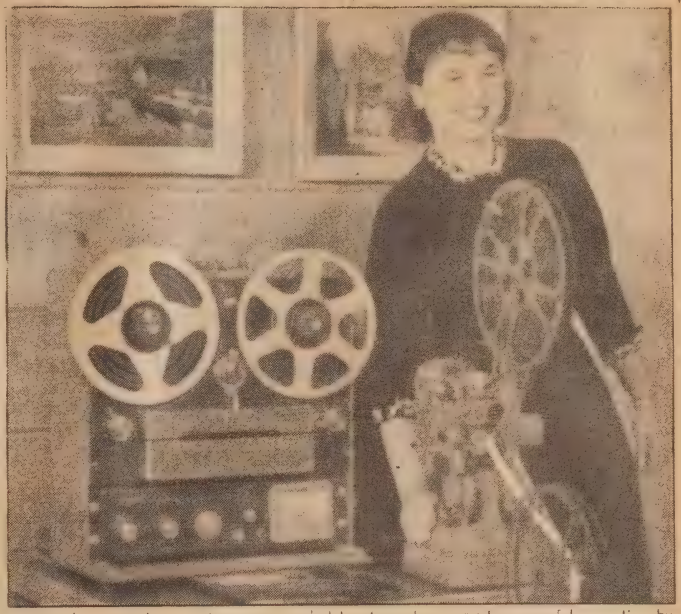
MAGNETIC TAPE CONTROLS PROJECTOR SYNCHRONISM

EXAMINATION of the many systems devised for synchronising sound to narrow-gauge motion-picture film indicates that most of them are complicated for amateur use, expensive, low in audio quality or not fully automatic. These shortcomings are avoided by a system of coincident sound comprising a tape recorder modified by adding a head to record and reproduce a synchronising tone, an amplifier producing 10 watts of power from the output of the auxiliary head, and a projector arranged for speed control from the synchronising amplifier. The modifications to both the tape recorder and the projector are relatively simple.



Exact and positive synchronism provided by the system permits successful operation by relatively unskilled personnel. The recorder can be remote from the projector if desired.

FIGURE 1 shows the recording system with signals from a microphone and a phono pickup mixed and half-track recorded on magnetic tape, while a 60-cps tone from the projector power line is recorded on the adjacent track.

Figure 2 shows the reproducing system with the audio track going to the sound channel, and the 60-cps signal fed through the synchronising amplifier to control the speed of the synchronous auxiliary motor on the projector.

Hence the power line frequency which controls the projector speed during recording is simultaneously recorded on tape for subsequent control during playback. The reproduced sound and the image projected on the screen will therefore remain coincident during playback to the same degree that they were during recording.

Maintaining exact synchronism between a tape recorder and a projector has always proved a serious problem for the home movie enthusiast. Simple mechanical coupling of the two units is not sufficient, since tape stretch can be quite serious. The following arrangement, from the Sept., 1957, Electronics, appears to provide a very effective solution. Note that references to 60 cps, etc., should be converted to 50 cps.

To assure the starting of the tape at the proper time with respect to the film, cue points are established on both media. A convenient method is to affix narrow strips of pressure-sensitive tape to the film leader and to the back of the recording tape. When the tape machine is threaded up, the cue marker is positioned at some definite point. The projector is then started, and as the cue marker on the film leader passes a predetermined point, the recorder is started and the tape assumes control of the projector speed.

LIP SYNC

The system can also produce "lip sync" by recording the sound simultaneously with photography, with the camera driven or controlled by a synchronous motor. The tape is later edited into the final sound track just as the filmed sequences are cut into the completed picture. System details will depend upon the equipment used, but most standard tape recorders and motion-picture projectors may be modified to a coincident sound system.

Projectors are usually equipped with a hand knob for checking film threading, which is connected directly to the shutter shaft. It then operates at one revolution per frame, or 16 rps when the projector speed is 16 fps. This knob may be removed and replaced with a gear, providing a convenient coupling to the synchronous control motor. The motor shaft usually rotates at 30 r.p.s. and the gear ratio between motor and projector should therefore be 30:16. A 48-pitch 32-tooth gear with a 1-8in face on the motor and a mating 60-tooth gear on the projector are an ideal standard combination. Although gear noise is not serious, the use of a fibre or nylon gear with one of metal will result in noise reduction. The loss of the testing knob presents no problem, as the projector motor switch can be snapped on and off quickly for a threading test.

When mounting the control motor to the projector it is supported on studs attached to the gear housing. These studs have one end tapped in the centre, and the other end tapped off centre. The resulting eccentricity permits a slight adjustment of the motor position for optimum meshing of the gears. The motor may also be mounted on a separate metal plate which in turn is secured by the gear cover plate mounting screws. This is recommended for projectors where the hand knob is in front and the gear cover plate is too small for the control motor.

The motor found most satisfactory for this application is Bodine type KYC26. This is an instrument chart drive motor, requiring only 10 watts of power at 1,800 r.p.m.

SPEED INDICATOR

Since this system provides for speed control rather than for positive drive, a projector speed indicator is desirable. A small neon lamp operated from the control motor power line will provide a stroboscopic light source. This illuminates the end of the lower film sprocket around the periphery of which 30 equally spaced holes have been drilled and filled with white paint.

The sprocket contains eight teeth, and rotates twice per second when the projector speed is 16 f.p.c. When the sprocket is illuminated by a 60-cps light source, the circle of white dots appears stationary. If the control fails, the dots will appear to rotate forward or backward, depending upon whether the projector is running fast or slow. For any other sprocket speed, frame rate, or number of strobe segments may be calculated from (2 x cps x T)/(rps x fps).

The recorder modification involves mounting an auxiliary record-reproduce head at a convenient point where the signal track on the tape will pass over the head gap. Recorders equipped for binaural recording and playback require no modification. The 60-cps signal is applied to the second channel for recording through a bridging circuit, and its output it fed to the synchronising

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The I.R.C. new loudness control consists of two separate volume controls operated from a single shaft of standard size and used with a combination of capacitors and resistors which are already wired. The unit will replace any volume control by transposing 3 simple connections, as indicated by the illustration at right. Can be fitted without experience.

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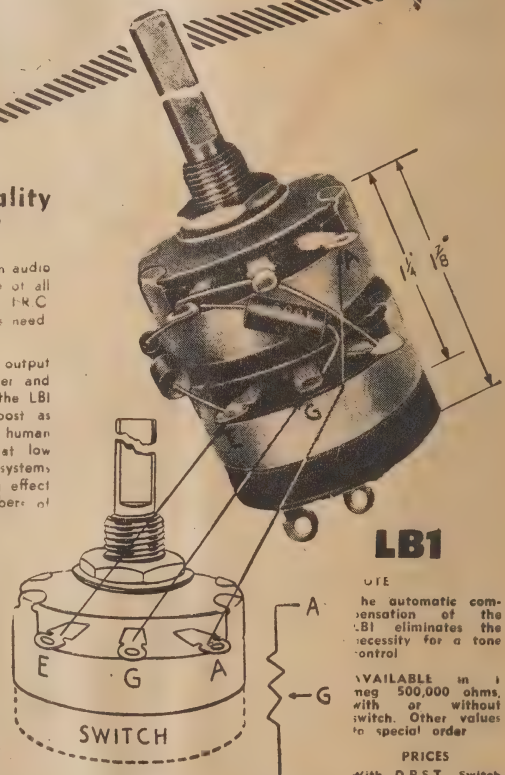

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amplifier on playback. On other recorders the Brush BK1090 head works well and is easy to install, since it requires only a single mounting hole.

Where an auxiliary head is installed on a standard half-track machine, the synchronising tone is recorded without bias. Six volts from the cathode heater supply is applied directly to the winding of the head. This produces complete saturation of the tape and results in a series of "blocks" of oxide which are of alternating polarity. It also automatically erases any previous recording. The waveform is shown in Fig. 3A. When the head is resonated at 60 cps a reasonably good waveform may be reproduced from the pulses as shown in Fig. 3B.

10-WATT AMPLIFIER

The synchronising amplifier may be any one capable of delivering 10 watts at 60 cps from the output of the auxiliary head, and having an output impedance of 500 ohms. Although this does not exactly match the impedance of the motor, it is quite satisfactory.

Stray magnetic fields are often present in the vicinity of the motors and transformers of popular-priced recorders. These fields may induce a low-level 60-cps voltage in the auxiliary head, resulting in a slow beat with the signal from the tape. If this causes the output of the synchronising amplifier to vary more than 10 volts, it will be desirable to arrange for some limiting action.

Any standard limiter circuit may be used, or it may be introduced into the power amplifier stage itself. A resistor of moderately high value inserted in series with the grid of each tube will provide all of the limiting necessary

DISTORTION UNIMPORTANT

Limiting will introduce distortion, but it is of little consequence in this application since the synchronous motor is insensitive to it. Since the motor represents an inductive load, a power factor correction capacitor will improve the overall performance and output waveform.

A suitable synchronising amplifier is shown schematically in Fig. 4. A switching arrangement either feeds 6.3 v to the head or applies the output of the head to the amplifier. The circuit is conventional except that the input includes a 10 uf capacitor for resonating the recommended head at 60 cps, the output stage includes limiting resistors, and a power factor correcting capacitor is shunted across the output transformer

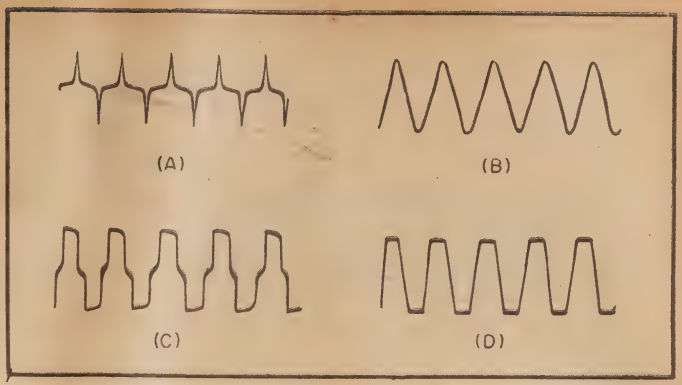

Fig. 3. Control signal waveforms at (A) output of auxiliary head, (B) input to synch amplifier, (C) output of amplifier after limiting, and (D) input to motor.

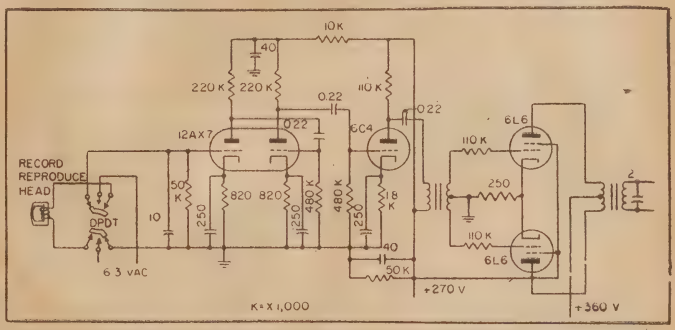

Fig. 4. Circuit of synchronising amplifier. Resistors in push-pull grids provide voltage limiting, and capacitors across input and output resonate head and motor.

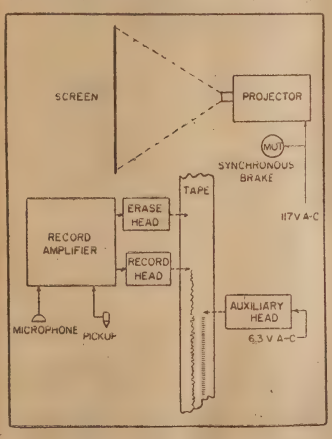

Fig. 1. The setup for recording sound for an existing film. A slightly more elaborate scheme allows synchronous recording while photographing.

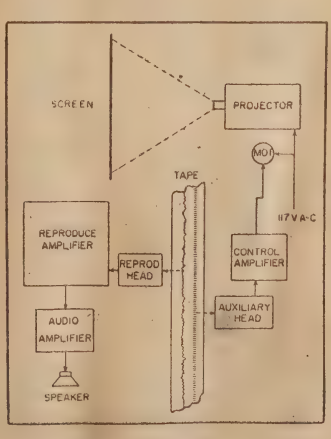

Fig. 2. The setup for synchronous playback. Note that the synchronous motor does not drive the projector, but merely controls the main drive motor.

The amplifier should be adjusted to produce an output of 110-130v when connected to the motor load.

Some adjustment is obtainable by changing taps on the output transformer or by varying the screen grid voltage on the output stage. Since limiting is involved, the adjustment must be accomplished in the final stage.

OUTPUT WAVEFORM

The limited output waveform is shown in C of Fig. 3 and the waveform as modified by the power factor capacitor is shown at D. While this departs appreciably from a sine wave it is quite satisfactory for driving the synchronous motor.

The control motor is operated, as a synchronous brake rather than as a motor. The best performance results from overdriving the projector with its own motor while using the synchronous motor to hold the mechanism down to speed.

HANDY TIP

Experimenters know that transistors, small resistors and similar components should be protected from undue heat while soldering. The easiest way to do this is to grip the wire lead with a pair of pliers between the component and the solder point. This job is a good deal easier if the stout rubber band is stretched over the handles of the pliers, leaving both hands free for soldering.

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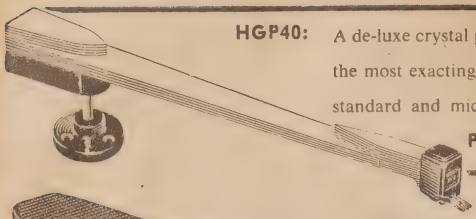

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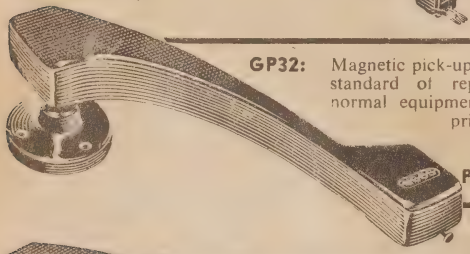

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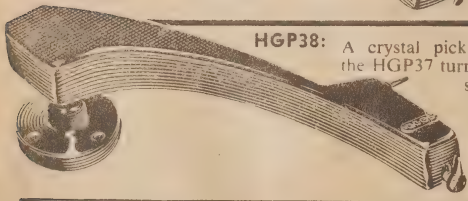

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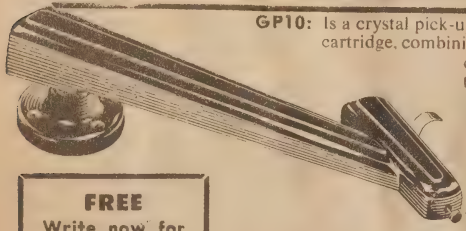

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NEWS AND VIEWS OF THE MONTH

Rocket Mail in 5 years

TRANSATLANTIC rocket mail delivery will be a fact by 1962, and "rocketliner" passenger travel may then be possible.

These are the predictions of a group of German rocket experts.

They base the rocket mail service prediction as much on the progress of their own work as on the implications of Sputnik, Soviet earth satellite.

Bremen's "society for rocket research," whose members worked on the Nazi V-1 and V-2 rockets, have spent five years on the postal rocket.

The Bremen scientists are rocketing mail with almost pinpoint accuracy to points 30 miles distant.

Their scale models prove rocket mail is technically possible.

The rocket mailmen have fired hundreds of scale-model postal rockets.

The organisation is seeking to interest the West German Post Ministry in testing rocket mail service between Bremen and Hamburg—60 miles.

"It is technically possible to build a postal rocket which would cross the Atlantic at around 3,000 miles an hour," say the experts.

"We could build such a rocket for only the small part of the cost of a jet airliner.

"On an intercontinental flight a rocket requires fuel for only about 90 miles—60 miles up to altitude and 30 miles descending.

"Rocket passenger travel is simply a matter of expanding techniques employed in rocketing mail and cargo.

"If man can travel to the moon, how much simpler it would be merely to rocket off to Calcutta or Zanzibar."

New Fire Extinguisher

AN electric fire extinguisher can put out a blaze faster than foam or water.

Known as the "powder puff," it has been produced by a British company.

Its main use is to deal with outbreaks of fire in Britain's growing chain of atom and electric power-stations.

The "powder puff" is mainly composed of bicarbonate of soda, so fine that it could be used as a talcum powder and so harmless that it could be eaten.—A.A.P.

★ ★ ★

No more barnacles

A REVOLUTIONARY device now being used in Australia will save shipowners thousands of pounds.

It is an electronic device which prevents barnacles growing on the steel hulls of vessels.

The device sends supersonic sound-waves through the steel hull, shaking off the growth.

Scientists found in several years of research that the barnacles were allergic to a certain frequency vibration.

This is between 17 and 20 kilocycles a second.

The vibration cannot be felt or heard by passengers and crew.

Engineers also say the device makes it unnecessary to paint hulls in future with an anti-fouling compound.

This also represents a big saving to the shipowner.

The equipment has a transmitter unit which generates a high frequency current.

This current is transformed into mechanical vibrations, which are transferred to the hull of the ship by transducer.

Atoms Ships soon

AN atomic merchant ship will be built within the next few years, according to Lloyd's.

Lloyd's chief engineering surveyor is a member of an atomic energy committee set up by the British Shipbuilding Research Association.

The company has been working for seven years on the problems connected with development of nuclear power for ships.

Atomic-powered merchant ships, such as tankers and freighters, are now a possibility, reports indicate.

★ ★ ★

Missile defence

U.S. scientists are experimenting with a sand cloud plan to counter the threat from inter-Continental ballistic missiles.

Scientists hope to counter the I.C.B.M. with a dense cloud of sand-like particles hurled into the path of an I.C.B.M. with such terrific speed that the missile's warhead would explode before it reached its target, and a nuclear fireball or radiation field creating enormous heat that would melt an I.C.B.M.'s warhead.

Only a relatively small area needed to be defended against the approach of an I.C.B.M.

The nature of a ballistic missile—its adherence to a pre-committed course—makes it possible to compute its course and effect an interception.

Investigations indicate that at very high impact velocities, very small projectiles have an explosive effect completely out

POPULAR SCIENCE QUIZ

Q.: I have seen mention of aluminium wire used for loud speaker voice coils. Is the use of such wire common?

A.: Aluminium wire is coming into more frequent use for certain purposes, particularly where weight is an important factor.

A recent development in this field is the technique of anodising the wire in order to produce an insulated coating. For many years it has been the practice to produce insulated copper wire covered with a film of enamel which is often very tough and flexible.

Scientists have now discovered a method of anodising aluminium wire to give good insulation at temperatures which would burn up the enamel.

Tested with the ordinary twist method, a breakdown of the anodised film of 250 to 280 volts, can be achieved, and insulation is reported to be satisfactory up to 300 degrees C. Sizes range from 16 gauge to 26 gauge, although wires as fine as 36 gauge have been made.

Q.: Is it true that milk turns sour during thunderstorms.

A.: It is generally agreed that there is no foundation for this widely held belief. If milk should turn sour during such periods it is almost certainly because of the higher temperatures before the storm and weather conditions which can favour the growth of bacteria in milk not otherwise protected.

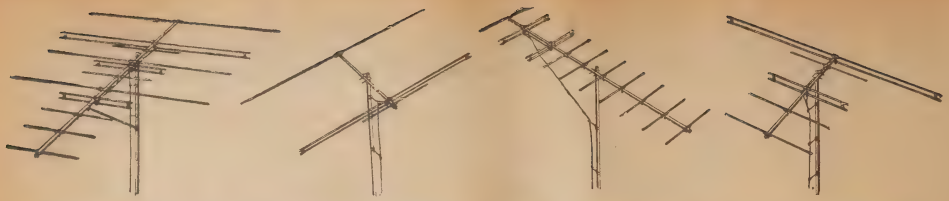
The thunderstorm as such has nothing to do with it.

Q.: Does the moon emit radio signals?

A.: There does not appear to be any evidence that the moon emits radio waves originating in itself. But the moon will reflect radio signals which strike it just as will any other body. Some years ago radio scientists, including some in Australia, sent a powerful set of radio pulses in the direction of the moon and received pulses in return which were obviously reflections of the original signals. The pulses had suffered some mutilation in their long journey, but identification was unmistakable. Since then signals have been bounced from the moon on many occasions, even by amateur experimenters. There is no technical reason against it.

Q.: Biologists can tell us plenty about the mechanics of hearing and of sight. But how do we smell?

A.: No one seems to have discovered just how we smell things. It is believed that the smell of any thing is a property of the molecules of which it is made in which their shape and rigidity play a big part. Quite small changes in structure can greatly change the smell associated with them. The nearest definition seems to be that we smell when "odorous" molecules come into contact with certain brown granules in a small mucous area at the back of the nose.



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of proportion to the impact effect normally expected.

This suggests the possibility of using a dense cloud of sand-like particles over the approach flight cone of the I.C.B.M. to explode the warhead.

The I.C.B.M. flight path that could strike a particular target area from any launching site would be an elliptically-shaped, curving cone inclined toward the target at an angle of 30 degrees.

A defence system could keep this cone under constant watch and intercept missiles.

STAFF VACANCY

WE have a staff position vacant for a competent radio technician with a good general background, and ability to construct and service radio equipment of all kinds. Experience in the servicing of FM mobile radio would be an advantage.

Applicants should apply by letter to the Editor, Radio TV and Hobbies, Box 2728C G.P.O., Sydney giving personal information and details of experience.

Eyes for Aircraft

AIRCRAFT engineers are trying to develop mechanical eyes to avert plane collisions.

Pilots at present have to rely on their natural eyesight.

When two jets, each travelling at a "lazy" 525 miles an hour, are on a head-on collision course, each is moving one mile in seven seconds.

If the two pilots see each other at a distance of eight miles, their combined closing speed allows them a slim 28 seconds to alter course.

It is not easy, however, to see an aeroplane at a distance of eight miles.

Often it is merely a speck on the windshield, and its course and speed are extremely hard to judge.

The problem becomes far more complex as speeds increase.

The Lockheed F-104A, for instance, is capable of speeds in excess of 1,500 m.p.h.

If two such planes were flying on a collision course, pilots relying on eyesight alone would have only about nine seconds to alter course.

That is far from a safe margin, and is one of the reasons why the aircraft industry's human factors groups are interested in developing mechanical "eyes" which can see for great distances.

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Senior Radio Telegraphist (2 positions) £1258 — £1318 p.a.

Qualifications: First-class Certificate of Proficiency (P.M.G.) or equivalent; ability transmit at 25 w.p.m. and use typewriter for reception radiograms at 30 w.p.m.; two years' commercial experience desirable, preferably in coastal radio or marine service; ability control and train staff.

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Qualifications. Second-class Certificate of Proficiency (P.M.G.) or equivalent; ability transmit at 25 w.p.m. and use typewriter for reception of radiograms at 30 w.p.m.; one years' commercial experience desirable.

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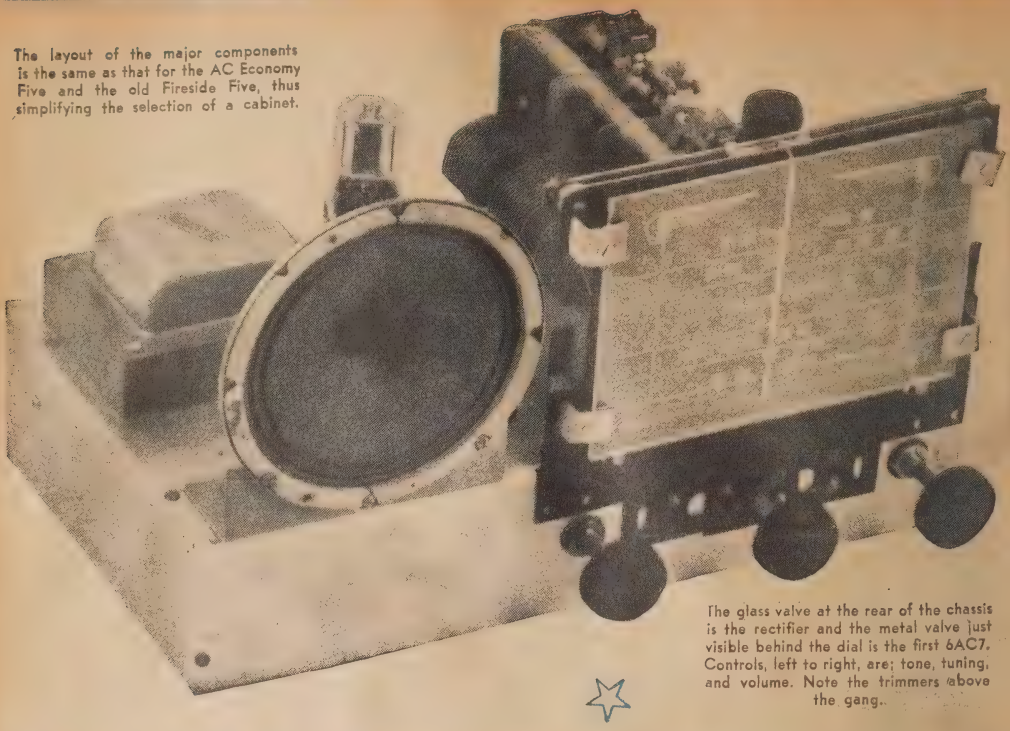
Taxation. Income derived by residents of Territory from sources within Territory, is not at present taxable under Commonwealth legislation.

Further Information: An information handbook on the Public Service of the Territory is available from the Department of Territories, Canberra or Sydney, or from any Commonwealth Public Service Inspector, Commonwealth Employment Office or official country Post Office. Other enquiries to Department of Territories, Canberra (phone UO411, ext. 29a).

Applications. Submit on prescribed form available from offices mentioned under "Further Information."

TO—The Secretary, Department of Territories, Canberra.

31st December, 1957.



The layout of the major components is the same as that for the AC Economy Five and the old Fireside Five, thus simplifying the selection of a cabinet.

The glass valve at the rear of the chassis is the rectifier and the metal valve just visible behind the dial is the first 6AC7. Controls, left to right, are; tone, tuning, and volume. Note the trimmers above the gang.

The TRF Economy Five Receiver

Here is a set many readers have been asking for—a TRF version of the AC Economy Five described last September. As with its predecessor, it is intended to take advantage of cheap valves and other components at present available on the disposals market. It may also help you use up some of those odd components in the junk box.

by Philip Watson

THE TRF enthusiast, it seems, is destined to be always with us, and there is always a small but steady proportion of our mail from readers who, for one reason or another, prefer this type of receiver to the normal type of superhet.

We were hardly surprised, therefore, when the September issue brought forth immediate requests for a TRF receiver along the same lines, together with the usual reasons readers give for preferring this type of receiver.

Just to keep the record straight, perhaps we had better say right here and now that we have no particular weakness for this type of receiver, even though we recognise that individuals might often have very good reasons for wanting to build one.

This article is, therefore, essentially, a request project; you have asked for a cheap TRF design and we have produced it. If you feel that it is likely to suit your requirements, then go ahead and build it; but, remember, we make no special claims for it.

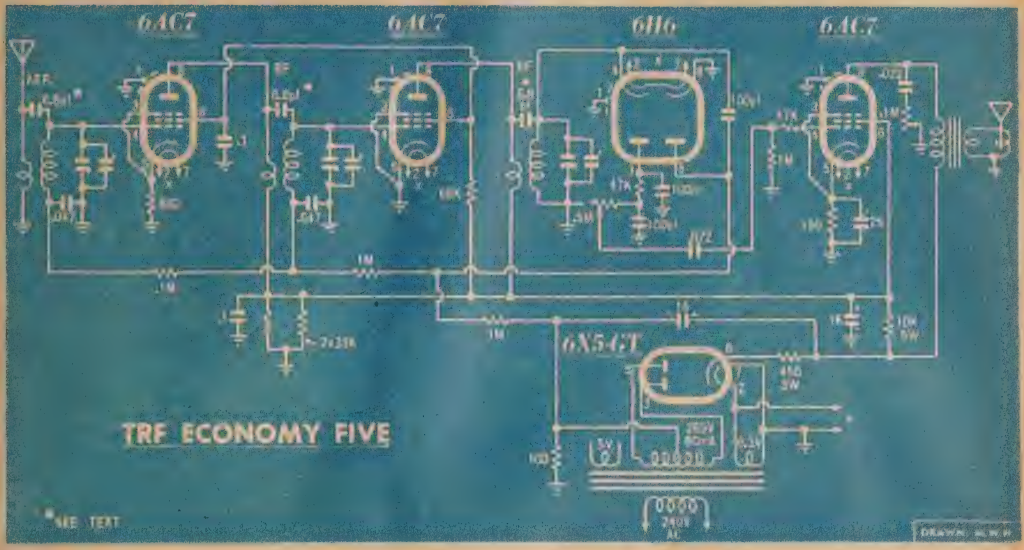
Before going any further it might be just as well if we considered some of the points for and against this type of receiver and whether or not it is going to offer you, the potential builder, any worthwhile advantage over the conventional superhet receiver.

There are many claims made by the members of the TRF cult, but they may be roughly grouped as follows: (1) The TRF is easier to build and therefore better suited to the beginner. (2) The TRF is cheaper to build, and, (3) The TRF gives better reproduction (or "tone") than the superhet. This last advantage is considered by many to be so overwhelming as to justify almost any amount of trouble to produce such a set.

Let us take these points in turn: First the question of being easier to build—and get going satisfactorily. It seems likely that many beginners make the error of confusing ease of understanding with ease of construction.

Because the TRF employs simple basic principles most beginners find it relatively easy to understand how the thing works; much easier than the complex business of trying to understand local oscillators, heterodyne beats, and all the

CIRCUIT DIAGRAM OF T.R.F. ECONOMY FIVE RECEIVER



The circuit is quite straight forward, the addition of AVC being the main difference between this and older style TRF's. Note the unbypassed cathode resistor in the first 6AC7 circuit, and which is used to control gain and stability. The simple power supply filter is a worthwhile economy feature.

other processes peculiar to the superhet.

From here it is only a step to believing that such sets are as easy to build as they are to understand and that they are thus ideally suited to the beginner. This theory is boosted somewhat by the fact that the very early superhets really were complex, as well as requiring new and (at that time) special components. And so the idea has persisted.

The truth is that there are many reasons why the TRF can present plenty of problems, even for the experienced worker, and it is these very problems which caused this type of circuit to be discarded so many years ago.

The main problem is that of stability. It is extremely difficult to provide a high order of gain at radio frequencies without some of the amplified energy finding its way back into the input circuit and causing oscillation. As a result, we must compromise between adequate gain on the one hand, and stability on the other, an arrangement which often limits the gain severely.

VARYING GAIN

This problem is further aggravated by the fact that the gain of such sets is not constant over the tuning range. As well as being an undesirable characteristic in itself, this often means that the gain at one end of the set must be seriously prejudiced in order that the set will remain stable at the other end.

In practical terms this all boils down to the need for very careful design, not only of the circuit but, even more important, of the chassis layout and wiring. In turn, this infers equally careful construction and wiring—something which the beginner may not always be able to provide.

As a result, what looks to be a delightfully easy circuit may well turn out to be an uncontrollable electronic monster, flatly refusing to behave in the manner that elementary theory suggests it should.

Another point which is often raised along these lines is that the T.R.F. is easier to align than the superhet., particularly where the builder has no equipment and must work "by ear" from broadcast station signals.

Once again, this is only partly true since such alignment is only a "rough and ready" process in either case. On this basis, it is possible to do virtually as good a job with one as with the other. Admittedly, the I.F. channel may not be exactly on the intended frequency, but the set will still work, and work well.

Next, there is the question of building costs. If we allow that such things as power supply, audio system, loudspeaker, etc., are common to all sets, we find that the main points in favour of the T.R.F. is that it uses one less coil than the superhet. On the other hand, it requires a three-gang tuning capacitor, instead of a two gang, and this just about cancels out the advantage.

This leaves us with only a few minor

PARTS LIST

1 Chassis 12½ x 7 x 2½
1 USL/44 dial (to suit gang)
1 3 gang capacitor
1 Aerial coil
2 RF coils
1 285V/60mA power transformer
1 5in. speaker with 10,000 ohm tran.
5 Octal sockets

VALVES

3 6AC7's, 1 6H6, 1 6X5.

CAPACITORS

1 25 mfd 25V Electrolytic
2 16 mfd 350V Electrolytic
2 .1 mfd 400V paper
2 .047 mfd 200V
1 .022 mfd 200V
1 .022 mfd 400V
3 100 pf mica
3 trimmers
3 6.8 pf mica or ceramic

RESISTORS

3 1M ½W
1 .5M potentiometer
1 .1M ½W
1 .1M potentiometer
1 68K 1W
2 47K ½W
2 33K 1W
1 10K 5W
1 680 ohms ½W
1 450 ohms 3W
1 150 ohms 1W
1 100 ohms ½W

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components associated with the oscillator stage, and worth only a few shillings at the most. On this basis, the difference in cost would be negligible, considering the total amount which must be spent, anyway.

And, finally, there is the question of improved reproduction in favour of the T.R.F. This is one of those stories that dies extremely hard, in spite of what has already been written on the subject. It is based on the assumption that a superhet is too selective to allow full reproduction of all the sidebands which the transmitter radiates, thus leading to severe attenuation of high frequency response.

This assumption is quite valid, but the reasoning which follows is more suspect. This is to the effect that, since the T.R.F. is a less selective set, it must give less attenuation of the sidebands and better high note response.

FALLACY

It is true that the T.R.F. has less selectivity, but the fallacy is in assuming that this automatically results in any worthwhile improvement in high note response. If this appears to be a contradiction in terms it should be remembered that the shape of the response curve is the most important factor governing this characteristic.

The superhet is able to provide a very steep sided response curve, giving an excellent order of adjacent channel rejection, even if at the expense of some sideband loss. Examination of a T.R.F. response curve will often show that, within the limits of the station sidebands, the response is very similar and gives a similar order of sideband loss.

It is beyond this point that the main difference occurs, the T.R.F. response falling away slowly and being wide open to adjacent channel interference. Thus we gain little in the matter of audio response, yet seriously worsen our adjacent channel rejection. We have gained little and lost a lot.

The foregoing discussion refers to an ordinary T.R.F., with the seemingly inevitable amount of regeneration. As the regeneration increases, short of actual instability, so does the "nose" of the curve sharpen rather alarmingly.

OUR EXPERIENCE

These statements are based on measurements we have made in our own workshop on both T.R.F. and superhet tuners.

And so—bang goes another myth (We hope!)

In the face of all the above comments the reader might well ask why we bothered to describe such a set at all, for there seems to be no point in its favour. Well, as we said earlier, one reason is simply that our readers asked for it, and, if they are all that keen on such a set, they might just as well work to some organised plan.

But more than that, and strange though it may seem, we can make a case for such a set. It is based purely on the current local market conditions, where quite a number of valves and other components are available at a fraction of normal market prices, which offer considerable attraction to the experimenter.

If, in addition, he has on hand such parts as a tuning capacitor, coils, etc., which are more suited to a TRF than a superhet, then it would be quite natural for him to hesitate before passing these over in favour of buying new parts in order to stick to the superhet circuit.

Provided the limitation and problems of the circuit are fully appreciated beforehand, and are quite acceptable, then such a choice is a perfectly logical one. By making it possible to use otherwise useless components, plus cheap disposals valves, etc., this circuit may well result in the building of a useful "second set" for only a few pounds.

And that's an advantage anyone can appreciate.

The circuit we finally evolved is a perfectly standard arrangement, though we considered several alternatives before adopting it. One was the use of a single RF stage, followed by a regenerative detector; this having the advantage of requiring only a two-gang tuning capacitor. We discarded it mainly because such sets are of doubtful value where unskilled users are concerned.

EXTRA AUDIO

Another idea, and one which we may yet try, was the addition of an audio amplifier, probably another 6AC7, ahead of the output stage. The extra gain which this would provide would be extremely useful, and should not present any complications.

However, the circuit as it stands is capable of perfectly satisfactory performance on local stations, and represents about the simplest form in which we could make such a set.

The power supply and output stage are similar to the AC Economy Five, the main difference being the increase of the filter resistor from 5,000 to 10,000 ohms. This is due to the lower drain of this set. There was no point in changing the operating conditions of the output stage, which is capable of delivering a surprising amount of power for such a valve.

The output transformer is a conventional 7,000 to 10,000 ohm type, and this works quite well, even if it is not exactly optimum. If higher values are available they may be tried, but the difference is not likely to be significant.

DETECTOR AND AVC

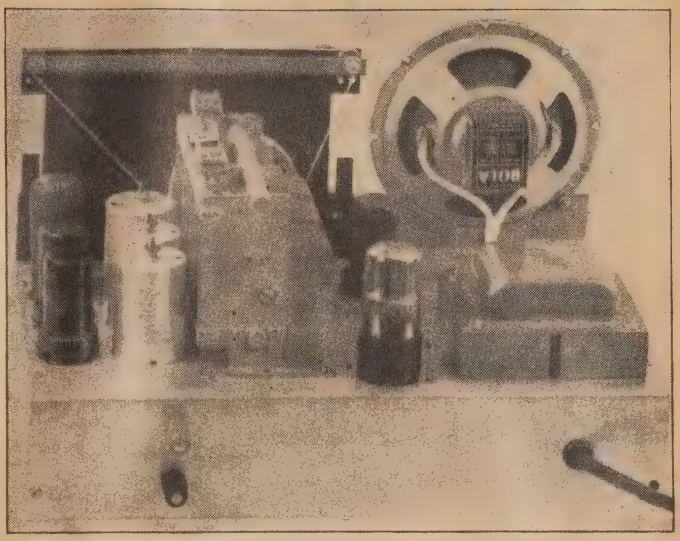
We also retained the 6H6 as a detector and AVC generator, though we have modified the circuitry slightly to accommodate the RF coil and earthed tuning capacitor. The main purpose behind the change is to keep the diode load network as far away as possible (in the electrical sense) from the cathode of the 6H6 in order to minimise hum pickup due to heater cathode leakage.

Ahead of this we have two 6AC7's as RF amplifiers in a perfectly conventional arrangement. Bias for these stages is provided from the 100 ohm back bias resistor, via the AVC line, while the first stage has an un-bypassed cathode resistor of 680 ohms. This latter is not so much to provide extra bias, but rather to introduce degeneration of sufficient order to make the set stable.

As we anticipated, the gain provided by the two 6AC7s is more than can be controlled in a set of this nature, and means must be provided to reduce the gain to the point where the set is stable. The unbypassed cathode resistor is a simple method of doing this.

There is plenty of room for experiment here. If the set is still unstable, additional resistance may be added to the second stage, while less resistance

A REAR VIEW OF ECONOMY FIVE



On the left are the two 6AC7 RF stages and the 6H6 (furthest from camera), with the rectifier and output 6AC7 on the right. There is plenty of room for other power transformer types, or an extra audio stage if necessary

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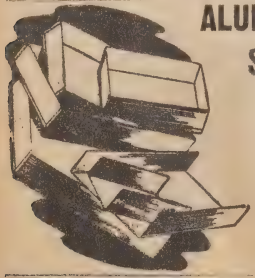
It will be seen that a resistor need not be the precise value marked in the circuit. For example a 47K resistor may range from 42.3K to 51.7K, hence a 45K or 50K is satisfactory—or even a high tolerance 39K, which would be 42.9K.



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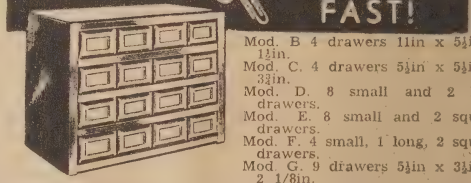

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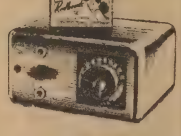

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in the first stage may possibly be tolerated without instability in some cases.

Screens for the two 6AC7s are joined together and fed from the 150 volt HT line through a 68K dropping resistor. The resultant voltage should be between 90 and 100 under no signal conditions.

Notice particularly the 6.8 pf. "top coupling" capacitors associated with each coil. These were necessary in order to lift the gain of the set at the high frequency end, and the story about this is rather interesting.

In the early days of TRFs there was a marked tendency for the gain to be higher at the high frequency end, due to the more effective coupling between primary and secondary at the higher frequencies, also the better L/C ratio. With the advent of the superhet it was possible to provide much more constant gain, though the aerial coil and RF coil (if used) still tended to favour the high frequencies.

Then someone conceived the idea of making the primary winding large enough so that its natural resonance was slightly lower in frequency than the lower end of the broadcast band. This raised the low frequency gain to such an extent that it often exceeded the HF gain, thus reversing the problem.

To counter this, it was found necessary to fit some top coupling between the two windings in the form of a small value of capacitance. This increases with the frequency and tends to even things up once more.

CUMULATIVE EFFECT

However, it is seldom that three such coils are used in cascade these days and they are certainly not designed for it. In our case, we found the combined efforts of all three resonant primaries was very evident, the low frequency gain being many times that at the other end.

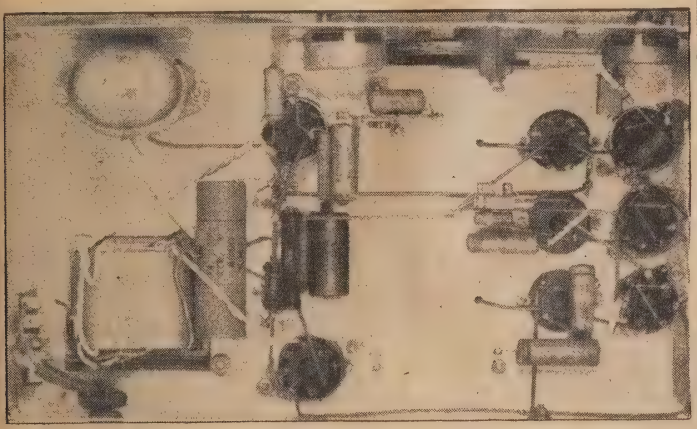
When we found that the particular make of coils had no built-in top coupling we tried various values across the appropriate base pins, finally settling for the 6.8 pf. shown. The gain still favours the low frequency end, but the difference is not serious. The particular coils used should be checked and the external capacitors added only if they are not already fitted internally. Sometimes this is nothing more than a twisted pair of insulated wires.

There are a number of low-price components currently available which will suit this set. All the valves are being offered at very keen prices, while there are at least two sources of cheap but perfectly reliable RF and aerial coils.

Full-size gangs, which are no longer standard, are often available at bargain prices, and the keen shopper will doubtless smell them out.

The power transformer may take a variety of forms. The total current drain is only about 30 mA, but it would be advisable to have at least 250 volts available in the secondary. Alternatively, one of the older 325 or 385 volt types may be used, the 450 ohm resistor being increased as required.

It is difficult to calculate suitable valves, and they are best determined experimentally. The voltages to be aimed for are (max.) 300 on the plate of the output valve, 150 on the screen, and 100 on the screens of the RF valves, all with aerial terminal shorted to chassis.



The general layout and placement of the major components can be seen in this picture. The two 6AC and RF stages and 6H6 detector are on the right, and the rectifier and output stage on the left. Tone control is on the left, volume on the right.

CHASSIS

For a chassis we had ideas about using the same Fireside Five chassis as for the AC Economy Five. However, this was not very suitable for a TRF layout, and we had to compromise with one the same size, but having a different layout. However, we have retained the same speaker, dial and control positions, so that the same cabinet could be used. A blueprint for this chassis will be available in the usual way.

The coils are mounted alongside the gang, with the two 6AC7's and the 6H6 alongside these again, near the edge of the chassis. The aerial coil is nearest the rear, close to the aerial terminal, and the detector stage near the front. The audio lead runs across the front of the chassis to the output valve.

The speaker transformer is mounted under the chassis beneath the speaker mounting bracket and in line with the power transformer at the rear. A five tag terminal strip mounted near the latter is used to terminate the various primary

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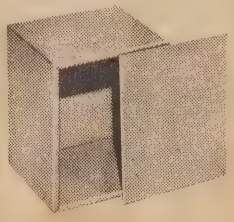

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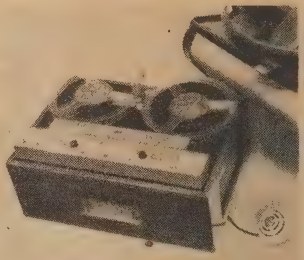

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tappings and the incoming mains lead.

On the other side of the transformer an eight tag terminal strip supports the 16 and 8 mfd. filter capacitors, the 450 and 10,000 ohm filter resistors, the 100 ohm. back bias resistor, and the .1 mfd. paper by-pass on the HT line.

Another five tag strip near the front of the chassis and parallel to it supports the .022 mfd. coupling capacitor, the 1M grid resistor, on end of the 47K stopper, and one end of the shielded audio lead from the volume control.

The tone control is mounted in front of the output valve socket, with the .022 mfd. running directly to the plate pin. The output valve bias components are supported between pin five and the earth terminal on the eight terminal tag strip.

TRANSFORMER CONNECTIONS

The HT and filament leads from the transformer may be run straight to their respective valve socket pins. If the transformer has a five volt winding this may be terminated on a couple of unused terminals on the eight terminal strip. A possible use for this winding is to supply the dial lights if used. This will take some of the load off the 6.3 volt winding and also prolong the life of the dial lamps.

Alternatively, if a 5Y3 is available in place of the 6X5, the five-volt winding may be used for that. This arrangement might deliver slightly less voltage but the difference would not be significant.

Over on the other side of the chassis we have the two RF valves and the detector/AVC valve. A couple of tag strips are used here also, but most of the components are self supporting.

Of considerable importance is the orientation of these valve sockets and the three RF coils. The two RF coils are mounted with pins number two closest to the edge of the chassis. The 6H6 has pin number three nearest the edge, but this valve is not quite so critical and may be rotated slightly if necessary for mechanical reasons.

COIL ORIENTATION

The coils are mounted with the "Grid" and "B-Plus" pins nearest the valve sockets, or "Grid" and "Earth" pin in the case of the aerial coil. While on the subject of the coils we will repeat the information we gave in the September issue concerning the coding on most coils.

No. 1, "G," or green is the grid terminal. No. 3, "F," or black, is AVC or earth. No. 4, "P," or blue, is the plate or aerial. No. 6, "B," or red, is B-plus or earth (for an aerial coil).

The critical leads in this part of the circuit are the grid and plate leads, and these should be run as direct as possible and as far from each other as possible. The exception is the grid and plate leads from the same coil which, being coupled together through the coil, anyway, will cause no trouble.

Other critical leads are those associated with the 1M resistors in the AVC network. These resistors must be mounted as close to pin 4 of the 6H6 as possible, since the lead to each is carrying RF current. However, the lead at the opposite end is by-passed and may be of any convenient length.

A two-terminal tag strip is used to support one of these resistors and to connect it to the lead running to the

(Continued on Page 79.)

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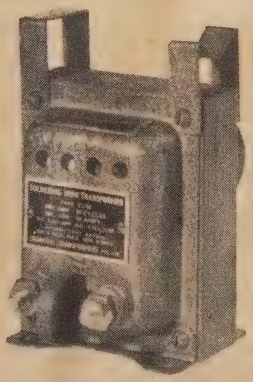

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PART 2—ROOM ACOUSTICS

All About Audio And Hi-Fi

Experiments with loud speaker placement show that the listening-room has a considerable effect on reproduction. If we cannot build our houses to suit our amplifying systems, at least we can make the best of what we have. In this, the second in his series of articles, the author relates some of his experiences and the results of experiment.

By G. A. BRIGGS

By special arrangement with the author and Radio and Television News, U.S.A.

Having dealt in a non-medical and non-technical way with the human ear, we naturally arrive at the room in which the ear is normally used for listening to reproduced music. Tonal discrimination must clearly involve an appreciation of what the room is doing to the sound.

Much has been written on room acoustics, but I still believe that the effects are greater than most people realise

SIZE OF ROOM

Some textbooks state that to reproduce a low-frequency sound the room must be at least as long as the wave-length you wish to reproduce, which means that a 50-cycle note requires a room nearly 24 feet long. The minimum usually advocated is half a wave-length, which means a 12-foot room for good bass down to 50 cycles, and I agree with this, but I do not agree that even smaller rooms are adequate.

As a matter of fact, a room about 11 feet long will have a main resonance at 50 cycles (with harmonics at 100 and 150 cps) and would tend to emphasise power-line hum from a noisy amplifier working into a good woofer.

It is clear that large rooms are better than small ones because the room resonances are lower in frequency and help to build up the bass in a region where it is often deficient.

Nobody says that a sound is inaudible if the room length is less than half the wavelength. It is simply not so well reproduced.

The obvious way to avoid small room effects is to move into a good concert hall, where it is possible to hear what a loud-speaker is doing **before** it is affected by reflections from walls, and where the room (hall) resonances occur at much lower frequencies, where they are less harmful.

I know of no quicker or better way of assessing speaker performance, and I am unable to understand why nobody else advocates this technique; my voice is still like one crying in the wilderness.

It is not suggested that the final choice of one speaker for domestic use—out of say half a dozen samples—should be made in a concert hall, where conditions are different (and superior), but it is claimed that the reliable information so obtained can be applied to good purpose.

CONCERT HALLS

I remember testing a speaker system with a new foam suspension to the cones, compared with a similar system with different cone surrounds, in St. George's Hall, Bradford, and in Carnegie Hall, New York, when everybody present immediately heard and appreciated the difference.

In short, a decision to adopt a new type of construction—cone, suspension, centreing device, or a different cabinet, baffle, or horn, or even a change to electrostatic units—can often be made in a few minutes instead of hours or days. This is achieved simply by improving the listening conditions.

Many of the effects to be observed cannot be produced by response curves taken in anechoic chambers or the open air.

Readers who do not own concert halls may wonder how all this affects them, and I agree it appears to be of rather doubtful value to amateurs. But there are thousands of halls which are used only a few hours a week, and serious investigators of sound reproduction could arrange tests without abnormal difficulty or expense.

They would at least learn by comparison something of what a normal living room actually does to sound waves.

ORDINARY ROOMS

To get back to earth (before the Editor starts using his blue pencil), a general outline of my own listening room at home is given in Fig. 1.

Apart from the fact that it is usually cluttered up with equipment and numerous loudspeakers (my wife is case-hardened), the furnishings, carpets and curtains are normal.

The room measures 20 x 14 x 11 feet, so the main resonances occur at about 28, 40 and 50 cycles, but the odd shape at one end helps to break up the horizontal modes.

At "A" there is a permanent 3-speaker corner installation, which gives better results than any speaker ever tested in any other position in the room—in spite of the rude things often said about corners and room resonance.

At "B," "C," "D" and "E" we do **not** find four more speakers, but simply one speaker tested in four positions. This is a 3-speaker sand filled baffle, measuring 34in x 31in, with 12in sides, with 12in and 10in units facing forward, and a 3in tweeter mounted on a separate small baffle facing upward.

The speakers radiate from both sides of the cones, and the main baffle therefore forms as a doublet at low frequencies (Fig. 6). (As the tweeter also radiates from two sides in a vertical direction, I suppose the whole system could be described as a "Quadlet," but I doubt if the Acoustical Society of America or if the A.E.S. will ever accept this new term!)

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A speaker which radiates in one direction only, say from a reflex cabinet, is known as a simple radiator (not a "Singlet") and appears to be less susceptible to room effects than a doublet. I have therefore selected the open baffle, stand-anywhere model as the basis of this test, because results were easier to observe.

Although a simple radiator does not behave in the same way as a doublet, many of the room deductions would still apply.

The first and most important lesson to be learned is that strong directional effects in middle and upper registers must be avoided like the plague.

RESULTS VARY

With a simple radiator this can often be done by facing the speaker into a corner or at an angle of 45 degrees towards a hard wall, so that the sound is splashed into the room and thus loses some of its "loudspeaker" quality.

In a good concert hall, undue directional effects give an even more unnatural result.

To revert to Fig. 1, the general conclusions are as follows, but it will be understood that other rooms, other speakers, other ears would give different results.

It is equally important to remember that results vary according to the type of record or radio transmission being used. Large choral and orchestral works often contain a good deal of studio colouration or ambience, which might clash with the room resonance. A rather dry, crisp recording is essential.

Solo voice is an excellent test, but a good, clean piano record is hard to beat, as the frequency range covers seven octaves and any "boxiness" in reproduction is easily noticed.

It is worthy of note here that the type of recording which sounds "right" in a good concert hall and is therefore free from excessive recorded ambience, is ideal for these tests, as it will not lead the ear astray.

Here are the findings for the various positions:—

ROOM RESONANCES

Position A.—This has already been awarded pride of place. The 3-speaker system in use here is not movable, in common with many reflex cabinets and back loading horns designed to give optimum results from a corner. In short, the speaker objects to being pushed around, so it cannot conveniently take part in the tests under consideration. Room resonance may or may not be prominent, but can easily be countered by the use of an extra speaker which may be comparatively small, suitably placed in the room. Experiments on these lines will be described in Part 3 of this series.

Position B runs very close to A, without exciting the full room resonance. Any speaker with a pronounced enclosure resonance around 50 cycles might sound better here than at A. Suits dance bands.

Position C.—A nice combination of medium bass and good reflection of rear sound waves. Suits most types of music.

Position D.—Ideal for those who prefer completely nondirectional effects. (There is no reason why the loudspeaker should always look the listener straight in the eye, or ear.) Very good on guitar and similar instruments. Room resonance well masked.

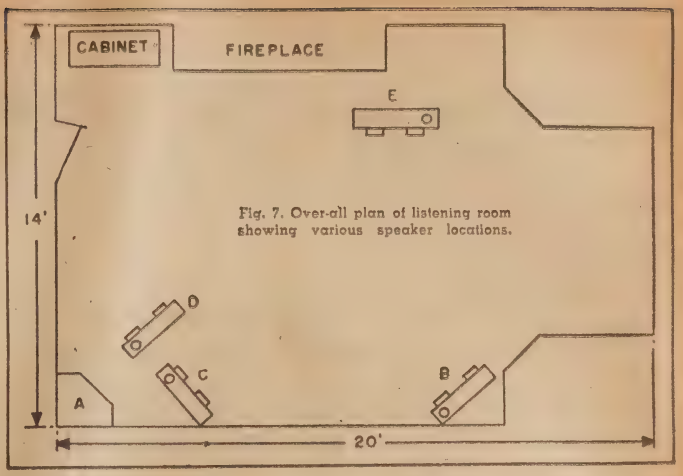

Fig. 7. Over-all plan of listening room showing various speaker locations.

Position E.—This position gives the impression that the music is being played in the room, rather than through a hole in the wall, and is liked by some listeners.

A-B TESTING

Some readers may suspect that the effects of speaker placing are being exaggerated, but an A-B test of two similar speakers often proves its importance.

For instance, if speaker "A" happens to be standing in a better position, acoustically, than "B," a preference for "A" might be transferred to "B" simply by transposing the speakers. This is another reason why large hall tests are safer; a difference of two or three feet in position is of no consequence, but in a small room this may be serious.

Load Matching.—Connecting an extra speaker in parallel with one already in use obviously halves the impedance, assuming that both speakers are the same. With modern negative-feedback amplifiers the output resistance is low and the damping factor is high, so a mismatch to the speaker load does not cause distortion—it merely reduces the available distortion-free power.

Assuming your amplifier will give 20 watts clean output, connecting a (perfect) 16-ohm speaker to a 16-ohm output circuit would make available the full 20 watts.

If you then add another 16-ohm speaker in parallel, and halve the impedance of the load, the available power is also approximately halved. If you are not using more than 10 watts at any time, there is nothing to worry about; but if you are likely to exceed 10 watts, it is desirable to change to an 8-ohm output tap or thereabouts for better results.

"Perfect" matching never comes our way, because speaker impedance varies with frequency, so it is only necessary to come reasonably near. For instance, an output circuit rated at 8 ohms is quite satisfactory with nominal speaker loads between 6 and 10 ohms impedance.

If two or more speakers are to be added in parallel it would be advisable to work on a low output impedance, say 3-5 ohms, so that more power becomes available as the extra power-handling capacity is increased by connecting the extra speakers.

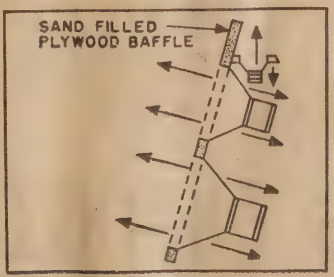

Fig.2— Double speaker system used.

IMPROVING MANTEL SETS

I hope these comments will encourage readers to try various experiments where room and furniture will permit. Even results from an ordinary radio set can often be improved enormously by removing the back and placing the cabinet across a corner at a suitable distance from the wall.

In Part 3 the use of two or more speaker systems in a room with single and/or two-channel input will be considered.

Many beginners are often in doubt as, to the manner in which speakers are phased.

The process is really quite simple and does not require any complex equipment. If several speakers are to be connected to a common output source either in parallel or through a network it is essential to phase them correctly so their respective acoustical outputs are additive.

To establish whether the speaker cones are pumping in unison simply connect a battery across the pickup terminals of your amplifier while watching the movement of the cones. The direction of mevent should be common to all speakers and it is a simple matter to reconnect the speaker leads until this is achieved. A 1.5 volt torch cell should be adequate for these adjustments.

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Here's your answer, Tom!

Ever eager to learn, Tom, this month has another batch of questions on a wide range of subjects. These range from fundamental electricity to transmission principles. Perhaps you too will find the answer to a number of problems that have been bothering you.

I have recently obtained a microphone and attached it to the pick-up terminals of my set, but all I can get when I turn up the volume is a howling sound. The set works well with a pickup connected, and I want to know what is wrong.

Your troubles, Tom, are more than likely due to a direct interference between the microphone and the speaker. Usually it is impossible to use a microphone in the same room as the loudspeaker unless the room is very large or the gain between them very low.

What really occurs is this: When you turn up the gain, any random noise that reaches the microphone is amplified and fed through to the speaker. The resulting sound from the speaker, in turn, reaches the microphone and is amplified still further and is again emitted from the speaker. This process keeps on, the sound building up in intensity until it is just a howling noise.

Unfortunately, the only cure for your trouble is to turn down the gain or to place the microphone in an adjoining room, where the sound waves from the speaker can't reach it.

People associated with the installation of public address systems are always up against this problem of "acoustic feedback" and are often forced to use selected microphones and directional flares in front of the speaker.

★ ★ ★

I have observed that many transformers in power supplies produce a filtered high tension supply in excess of their own voltage rating. For example, a 225-volt transformer is sometimes capable of producing 235 volts and even higher. Where do the extra volts come from?

We suspect, Tom, that this question has bothered many other readers. There is a perfectly good reason for this occurrence and it is not limited to a few isolated cases, for much the same occurs in an ordinary radio receiver.

The value of output voltage specified for the secondary is the RMS or effective value. If you were to draw a graph of the output of one-half of the secondary, plotting time versus voltage, you would obtain a series of familiar sine curves.

The rated voltage, whether 225 or 285 volts, will be about two-thirds the distance to the peak value on the vertical voltage axis.

Putting it another way, the peak voltage is 1.4 times the RMS voltage and is the highest value to which the voltage rises during any part of the cycle.

Since the rectifier plate is connected directly to the transformer, every time the transformer delivers a positive voltage the rectifier conducts and delivers energy to the filter circuit. The voltage at the cathode almost reaches the peak voltage output of the transformer, but it cannot follow downward excursions of the voltage at the plate, due to the presence of the filter capacitor.

The first filter capacitor receives the impulse from the cathode and charges to almost the peak value during the first few charging cycles. When the voltage output from the rectifier falls between these charging cycles, the capacitor tends to keep the voltage up to the peak level.

If there is no drain on the power supply and the capacitor is in good condition, the voltage will actually remain at a level close to the peak value. Any drain will tend to discharge the capacitor, thereby reducing the voltage. The heavier the drain the lower will the voltage become.

"For goodness sake don't bother me now —my television set just went wrong."

In the case of the 225-volt transformer you mention, the peak value delivered to the rectifier plate would be 225 times 1.4, equals 315 approx. volts. In the absence of load current, the rectifier cathode voltage would rise to almost 315 volts DC, which is a lot more than the original 225 volts AC RMS. With load current, the DC output voltage would drop below this 315 maximum volts, but a very heavy load current would have to be drawn from the supply to get it right down to the original 225.

★ ★ ★

My amplifier is making a popping sound when the volume is turned up, and someone suggested that it needs decoupling. Is this correct? If so, how do I accomplish it?

The sound you describe as popping is commonly referred to as "motorboating," and the remark regarding the decoupling is quite correct. This trouble, Tom, is brought about by coupling between high gain stages through the common power supply.

When the gain is sufficiently high and the coupling through the power supply sufficiently great, oscillation occurs. The frequency of oscillation is connected with the natural time constant of the power supply and is generally only of a few cycles per second. The lower the natural time constant of the power supply is made, the less are the chances of oscillation.

To reduce the time constant of the power supply, a large value capacitor may be connected between the high tension line and earth. However, to be effective, this capacitor has to be of a value which is often too large to be practical.

Decoupling, as suggested by your friend, now comes into the picture. This method consists of the introduction of some resistance in the power supply to the high-gain stage or stages bypassed at the high gain end by a large capacitor.

The function of this network is to isolate the stage by virtue of the resistance interposed between them, and to provide a low impedance path for audio currents through the capacitor to chassis.

However, in your case, the amplifier seems to have developed the trouble after being in use for some time, and you may assume that the trouble is due to a deterioration of some of the components.

The first to suspect are the capacitors in any of the decoupling networks. These may have dried up or become low in value through old age. There is no need to disconnect them from the circuit; simply try placing a good capacitor across them. The same procedure may be applied to check any other electrolytics in the amplifier.

★ ★ ★

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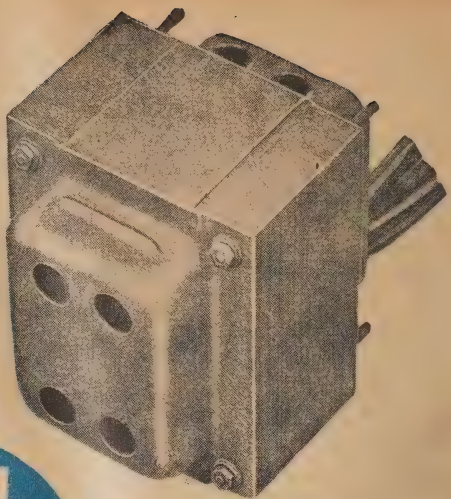

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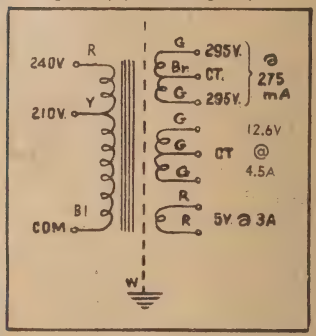

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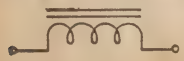

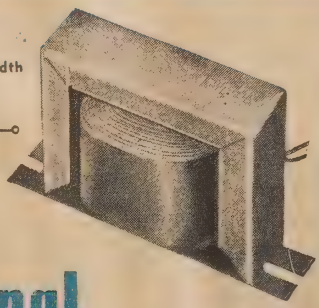

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RETAIL PRICE 206/9

modulation, visualise a steady carrier being broadcast by a transmitter and radiated into the ether by an aerial. The signal consists of countless cycles of radio frequency energy depending on the frequency at which the transmitter is operating.

This carrier is of little value to anyone tuning it in on a receiver. For although a meter would indicate the presence of the carrier, this carrier would offer no information unless some intelligence were superimposed on it.

The carrier could be interrupted in a manner corresponding to the Morse Code, for example, but that still would not enable you to hear music and voice which constitute the normal broadcast.

If you were to vary the carrier strength, say at an audible rate in sympathy with the musical tones and the human voice, then, through the process of demodulation in the receiver, it should be possible to reconstruct these musical notes and speech.

The process of modulation does exactly that. Weak pulses from the microphone or pickup are amplified so that they are comparable with the RF signal. The amplified audio is then applied to the transmitter so that the RF signal output is made to vary in sympathy with the audio signal.

When the carrier wave is amplitude modulated, the audio signals are made to vary the amplitude of the carrier wave and it is said to be 100 per cent modulated when the audio signals cause it to vary between almost zero amplitude and double its unmodulated value.

If the audio is increased beyond this, without special precautions being taken, the carrier just doesn't approach zero on peaks of modulation. It is interrupted completely and abruptly for significant periods of time and the transmitter causes what is known as "splatter" on adjacent frequencies.

This is a noise interference which upsets reception on adjacent channels and earns the disapproval of the licensing authorities.

★ ★ ★

I decided to install an emergency lighting system consisting of a 6-volt battery, some globes and a length of twin flex. The battery was located in the garage to prevent damage to furniture, etc., hence the length of flex. When the wiring was complete, I switched on the lamps and was surprised by the lack of brilliance compared to the result I obtained when connecting the lamps directly to the battery. Why is this flex suitable for 240 volts and not for six volts?

The answer to your question, Tom, is really just a simple example of Ohm's Law—the law governing the relationship of voltage, current and resistance in an electrical circuit.

You don't give any details, but let's assume, for the sake of argument, that you installed globes in the house rated to draw 3 amps at 6 volts. In other words, if connected directly across your 6-volt battery, each globe would draw 3 amps, consume 6 x 3 equals 18 watts of power and produce a very useful amount of light output.

But you did not have the lamps connected straight across the battery. They were connected to it by a considerable length of lighting flex.

Now lighting flex, like any other conductor, offers a certain amount of resistance to the flow of electrical current. Let's just say that it was 1 ohm from the battery to the lamp and back again.

Ohm's Law tells us that a current of 3 amps, as drawn by one lamp, flowing through 1 ohm, would produce a voltage drop of 3 volts. So one would expect half the applied voltage to be lost in the cable and only half to reach the lamp, making it glow in only a very dull fashion.

Actually, it wouldn't work out quite this way because, with only 3 volts applied, the lamp would not draw its full current. Therefore, there might be only a couple of volts lost in the cable, leaving about 4 volts for the lamp—still not enough to produce anything like full brilliance.

With two amps in operation and trying to draw even more current, the loss in the cable would be even greater. That, Tom, should explain why the lamps are not operating properly. But what about the "240-volt" part of your question.

Well, to give the same light, a 240-volt lamp needs only to draw a very small amount of current. Even a 24-watt lamp only draws 0.1 amp at 240 volts.

Now 0.1 amp of current, flowing through the same piece of flex, would only cause a voltage drop of 0.1 volt, so that the voltage available at the lamp would be reduced from 240 to 239.9 volts. The loss would be quite negligible.

So there it is, Tom. In an electrical circuit handling high current but low voltage, the resistance of the conductors has to be kept just as low as possible. When the voltage is high and the current is low, resistance doesn't matter nearly so much, and thinner conductors can be used.

But there's one thing you'll notice about the 240-volt lamp cord. It's generously insulated with a thick layer of plastic, both to prevent a short between the wires and to stop anything getting a shock from the high voltage.

★ ★ ★

Where do the sidebands of an AM signal come from? I can only visualise the carrier and the audio frequencies.

Sidebands in a transmitter are formed in much the same way as the intermediate frequency in a superheterodyne receiver. Sidebands are created through a heterodyne process and consist of sum and difference frequencies adjoining the carrier frequency. For example, suppose that the transmitter is operating at a frequency of one megacycle and that the modulating frequency is 3,000 cycles. The carrier frequency beats with the audio frequency to produce both the difference frequency (97 Kc) and the sum frequency (103 Kc).

If your receiver were sufficiently selective you would be able to tune in to the three separate frequencies. However, we deliberately make the receiver so that it responds to all three frequencies at the same time. When they are recombined at the detector and the high frequency components eliminated, all that is left is the 3 Kc audio tone.

★ ★ ★

I have read articles where Miller effect was mentioned and pentodes were suggested in place of triodes because of this phenomenon. What does Miller effect do to the signals?

Miller effect is a phenomenon which is noticeable in certain valves because of the input capacitance appearing very high and resulting in attenuation of the treble notes. The name stems from the person who wrote a very informative technical paper on this subject after investigating it.

A technical explanation of this effect would be far beyond you, Tom, so we will try to present it as a practical result.

All valves have a certain amount of capacitance between plate and grid. In triodes this capacitance is quite high, whilst in pentodes it is extremely low.

If a valve is arranged in an ordinary circuit, and the load resistance temporarily shorted, it would be possible to measure a certain value of capacitance between grid and ground. This is known as the input capacitance and is equal to the sum of the capacitances from grid to all other electrodes. The value is quite small, generally only a few pf.

If you remove the short and operate the valve normally, the value of input capacitance may soar to many times the original value, the reason being that the apparent input capacitance of a valve with a load resistance in the plate circuit is increased by the capacitance between the plate and grid multiplied by the stage gain of the valve.

From the foregoing you can see that when gain and the plate to grid capacitance is high, the apparent capacitance of the input circuit is also high.

The effect of this high capacitance across the input circuit is equivalent to placing a capacitor of similar value across the grid circuit and attenuating the higher audio frequencies.

In a pentode the plate to grid capacitance is so low that it is possible to use the full stage gain without appreciably increasing the input capacitance which remains quite low. That is one reason why you saw mention of a preference for pentodes in a high gain audio stage.

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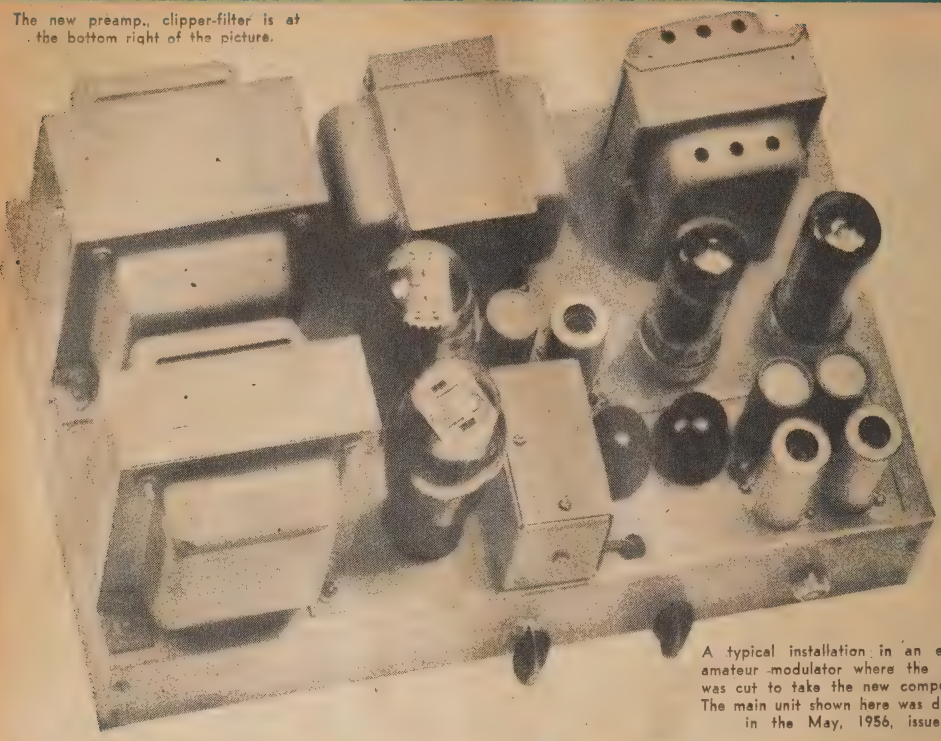
The new preamp., clipper-filter is at the bottom right of the picture.



A typical installation in an existing amateur modulator where the chassis was cut to take the new components. The main unit shown here was described in the May, 1956, issue.

A Clipper-Filter For Amplifiers

Every so often we work on a project about which we can be really enthusiastic. This time it is a speech clipper, filter and automatic gain control system which works so smoothly as to be almost unobtrusive. At the same time it makes the audio sound more than twice as loud for the same peak power. It was designed mainly with amateur transmitters in mind but may easily find applications elsewhere.

by Maurice Findlay

If you have ever fed a speech signal from a microphone into an oscilloscope with the time base set to a fairly low frequency and observed the waveforms closely, you cannot help but notice their jagged nature.

Another thing you will notice is that it is very difficult to speak at a constant level. You may start the experiment with the gain set so that average speech occupies about half the screen only to find that moving your head slightly brings the average level to fill the whole screen.

NATURE OF SPEECH

In general, then, the nature of speech is such that the peak amplitude is very much greater than the average and the average varies over wide levels.

There are plenty of cases where this is not too important. For example, when the microphone is fed into a public address system which has a peak power output capability much greater than the average power needed. At the same time there are plenty of public address systems which could be improved by some form of automatic volume control.

When speech is applied to a radio transmitter to modulate the carrier wave, two conflicting requirements have to be met.

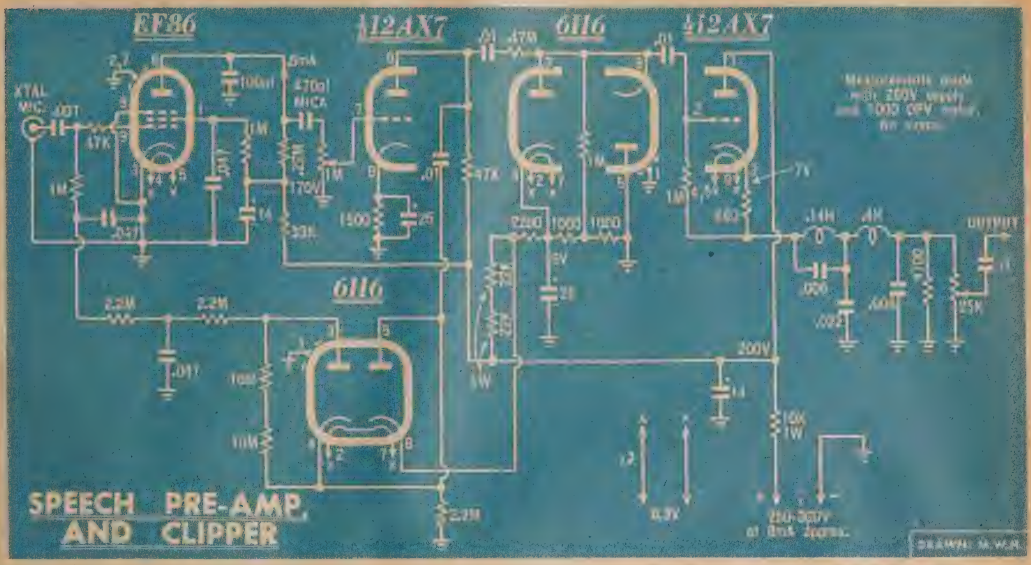
The first is that the maximum deviation in the case of a frequency modulated system should not exceed the set limits, or that the percentage modulation in the case of an amplitude modulated system should not exceed 100 p.c. In either case, exceeding the set limits will result in the transmitter occupying a greater share of the frequency spectrum than it should.

The second requirement, where communication transmitters are involved, is that the average deviation or modulation percentage, as the case may be, should be as high as possible without exceeding the maximum. The object is to make the best use of the available carrier power for communicating information

Because of the peaky nature of speech waveforms, these two requirements are in direct opposition. If the original sounds are to be reproduced faithfully and full modulation not exceeded, the average percentage of modulation must necessarily be low.

MODULATION PROBLEMS

In operating an amateur transmitter, we have received reports of low modulation from listening stations when an oscilloscope monitoring the transmission indicated that 100 per cent modulation was being reached on peaks.



Complete circuit diagram with all components together with significant voltages and currents marked. Half watt resistors may be used except where indicated. Your existing microphone preamplifier may be used instead of the EF86 stage shown. See text for discussion.

We would go as far as to say that most amateurs who transmit effective signals with low power do actually overmodulate consistently on peaks. This results in the transmission having a greater bandwidth than it should, and unnecessary interference on adjacent channels.

While overmodulation certainly cannot be recommended as a general practice, there are reasons why many amateurs are able to overmodulate without excessive interference. With an amplitude modulated transmitter, the modulating power is usually applied to modulated stage via a transformer. This transformer has its secondary bypassed with a capacitor, the value being chosen so the capacitor has a low reactance at the radio frequency involved.

In many cases, the capacitor, in conjunction with the leakage inductance of the transformer behaves as a low pass filter removing an appreciable amount of the high-frequency distortion components generated by overmodulation.

However, unless you are particularly fortunate, the results of such a simple filter are not likely to be really satisfactory and your signal will occupy a wider bandwidth than necessary.

CLIPPING

Experience has shown that it is possible to clip off the peaks of speech waveform without seriously affecting the intelligibility of final signal. More amplification can then be used, and the signal sounds louder without exceeding the peak amplitude of the original.

The amount of clipping which can be used depends on a number of factors, and it is not possible to give a rule to cover all cases.

However, in general, the peak-to-peak amplitude of the wave can be reduced to half normal with negligible difference in the audible quality of the received signal.

Regulations governing the operation of amateur stations limit the DC input to the plate of the final amplifier valve or valves to 100 watts. This is a relatively low power and to make best use of it, most amateurs employ plate modulation, the modulation being applied to the final stage. Increasing average modulation by a ratio of 2 to 1 (6db) is approximately equivalent to increasing the power to 400 watts, 100 p.c. peak modulation being assumed in each case.

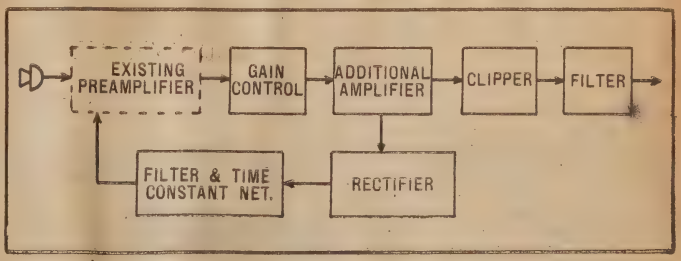
EFFECTIVE INCREASE

The same argument applies in the case of lower powered transmitters, and a 50-watt transmitter using, say, a single 807 in the final stage can be made to sound as effective as a 200 watt transmitter and at much less expense than increasing the carrier power.

Actually the effectiveness of the signal can be increased still further by heavier clipping, and the ratio of the peak to peak amplitude of the clipped signal to the original may be as great as 10 to 1 before intelligibility begins to depreciate. At high clipping levels the audio certainly sounds louder and would show up well in competition with signals on adjacent channels, but distortion is quite obvious.

Our view is that most amateurs take a pride in the general quality of their transmissions and would prefer not to carry the clipping technique to the point where it makes an appreciable difference to the quality. We have been guided by the same philosophy in establishing the frequency response curve of the complete preamplifier.

While clipping does reduce the peak amplitude of the signal, it results in severe distortion, and the generation of high frequency components. It can be shown that the corners of the square-topped wave which results from clipping are due to the fundamental, plus a series of harmonics. If allowed to pass through the modulator, these harmonics will cause the band occupied by the



A block diagram helps in the understanding of the detailed schematic circuit above.

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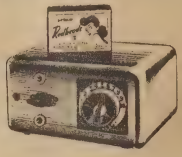

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transmission to increase in exactly the same way as overmodulation.

Therefore, an essential accessory to a clipping system is a low pass filter to remove the distortion components.

The frequency at which this filter should become effective then comes up for consideration. If the main consideration were merely the narrowest possible bandwidth, good intelligibility could be obtained with a filter, allowing little above 2 Kc/s to pass.

At the same time, when the bandwidth is extended to 3 Kc/s or 3.5 Kc/s, the general brightness and natural quality of the speech is very greatly improved. As you will see from the overall frequency response curve, our filter is about 5 db down at 3.5 Kc/s, allowing the transmission to sound perfectly normal. At the same time it does not occupy excessive bandwidth.

LOWER FREQUENCIES

While most of the energy in speech appears at the low frequency end of the spectrum, the lower frequencies contribute little to the overall intelligibility. Therefore, the signal can be made to sound louder without exceeding full modulation by attenuating the lower notes.

Again, the extent to which the lower end can be attenuated is a subject for debate. The optimum amount does, in fact, vary with the particular voice and different operators will decide that they would prefer more or less that the amount we have suggested. Our curve is about 6db down at 200 cycles, and gives a worthwhile improvement in effective modulation power without losing the roundness which goes with reasonable low frequency response.

You can only make a final decision after a number of tests on the air, but if you have a deep voice, up to 15 db attenuation at 200 c/s would not be unreasonable. (In all cases we refer the attenuation to a nominal centre frequency of 1,000 c/s.)

So far we have discussed clipping and the shaping of the response curve as means of increasing the effectiveness of the transmission. A third general method known as volume compression should be mentioned for the sake of completeness. In this case the ratio of maximum to minimum amplitude is reduced by an automatic gain control system with a time constant short enough to operate during the time of incoming speech transients. A good design would have an attack time of 100 microseconds, enabling it to deal with the sharpest transients likely to be encountered in speech for communication purposes.

COMPLEXITY

There is no denying the effectiveness of such systems, and when followed by a small amount of clipping the improvement in intelligibility is very good. The disadvantage is in the overall complexity The controlled stage usually has to be in push-pull in order to avoid "thump" effects, while it is often hard to avoid a pair of good quality audio transformers. Up to a dozen valves may be involved in the preamplifier alone.

Some amateurs would be prepared to go to the trouble of assembling and adjusting a compression system but the majority would have neither the time nor the test equipment.

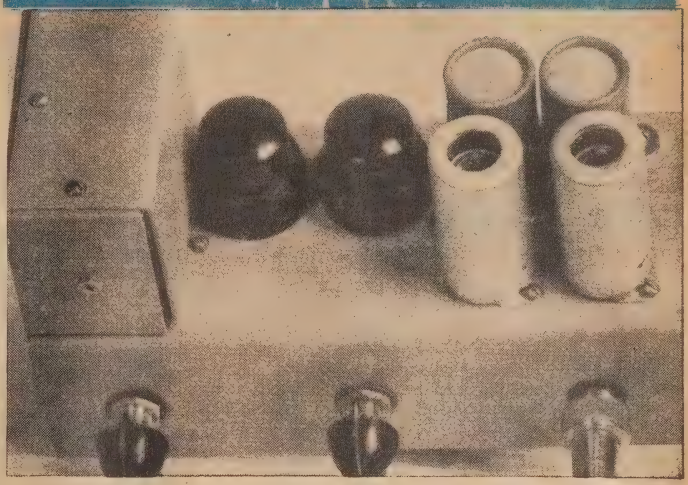
While true speech compression is hard to achieve there is no great difficulty in providing an automatic gain control system to compensate for changes in the average level of the speech signal. We refer to changes which result from different speaking distances. Although the normal speaking distance may be one foot, variations between 18 inches and six inches could reasonably be expected to occur at various times. Then there is the natural tendency to speak more loudly close to the microphone when in contact with a distant station under difficult conditions.

Without some form of control these variations are likely to result in little modulation on the one hand and excessive clipping with its attendant distortion on the other. The range over which satisfactory performance can be obtained may be extended greatly by a carefully designed automatic gain control circuit.

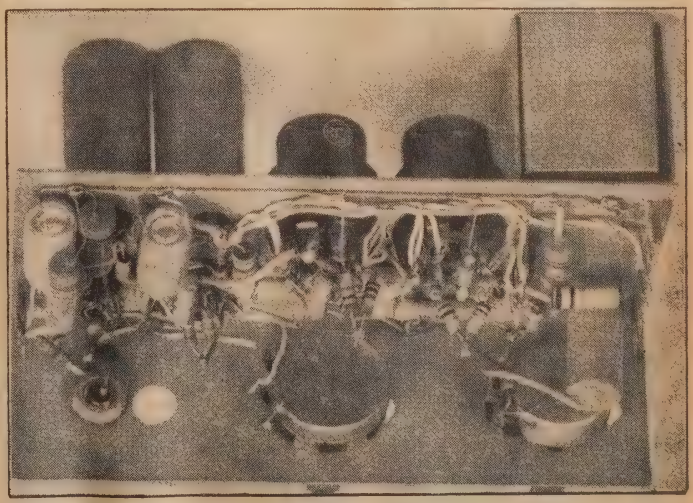
Some of the audio output is rectified and fed back to one of the early valves in the system in such a way that the gain of the stage is reduced as the input signal is increased. In order for it to be fully effective the time constants of such a system should be considered carefully.

A short time constant system controlling the gain over wide levels tends to rob the speech of natural qualities while a long time constant system is unable to take care of sudden increases in level. The best arrangement appears to be one in which the control has a short attack and a slow decay time. In this way it is able to deal reasonably well with sudden increases but tends to have its average value determined by the peaks

TOP VIEW OF COMPLETED UNIT



Except for the microphone preamplifier, the layout is not critical and the above is only one possible physical form for the new unit.



The very compact underchassis layout is made possible by some of the latest resistors and capacitors. There is no reason why you should not use older components if in good order, but be careful of older capacitors which often leak badly.

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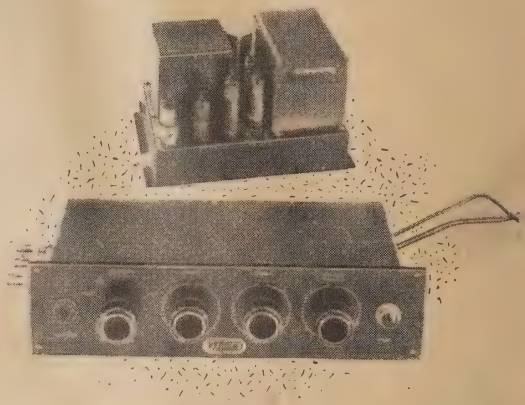

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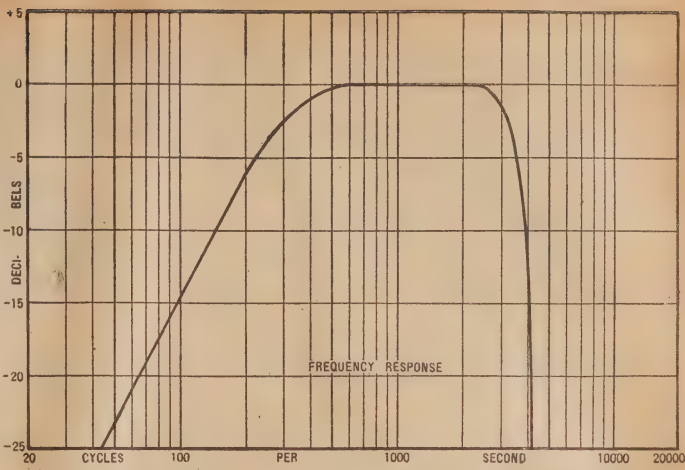
of speech. Thus the average clipping level can be held reasonably constant.

Actually, when speech begins suddenly after a period of silence with this system the first few milliseconds may be clipped more severely than the remainder, but since the period of heavy clipping is small compared with the total time of the transmission the slight delay in AGC attack time is not noticed.

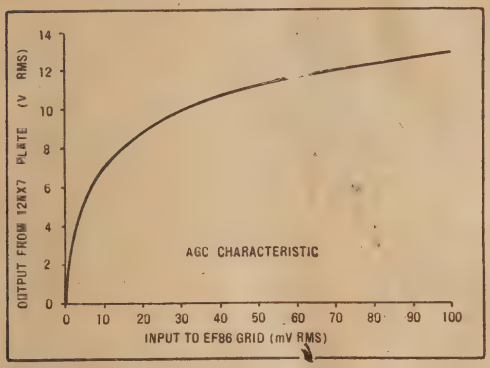
While discussing the foregoing design factors we have had in mind mainly a low level system suitable for insertion in low level microphone amplifier circuits. Many of the arguments we have brought forward apply equally to AM, FM single sideband or any other modulation system you may be considering.

DISTORTION

A possible disadvantage of a low level clipping and filtering system is that distortion components introduced by later stages in the system will result in wide bandwidth. Switching transients in a class B modulator due to excessive bias are one obvious and likely cause. Phase changes due to poor frequency response can result in changes in the relative peak amplitude of the clipped and filtered signal.



The frequency response curve of the complete unit, measured with the AGC inoperative. Although very poor by high quality amplifier standards, it is excellent for voice communication purposes.



☆

In practice, the output from a high quality crystal mic. will be 20 mV or greater under average speaking conditions when the clipping level will be held fairly constant as shown by the curve (left).

☆

For these reasons the characteristics of the driver and modulator circuits should be reasonably good. Some authors have advocated high level clipping systems operating after the modulator power amplifier and there is no doubt that there are points in favour of the idea. A major disadvantage is that high power chokes and capacitors with the correct values are not always easily obtainable. Even if available, they are both bulky and expensive.

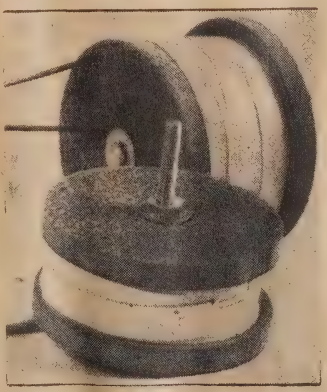
LOW LEVEL SYSTEM

For the above reasons we decided to concentrate on a low level system which could be designed to occupy a few square inches on an existing speech amplified chassis. The high level clipping is limited to AM transmitters, but the low level system will find many other applications.

Having briefly covered the background of the subject we can now begin to study the practical design.

If the average level is to be increased and then clipped it is obvious that further amplification will be required. A block diagram shows the essentials of the system in which the additional amplifier is followed by the clipper and finally the filter to remove the distortion components.

The portion of the signal to develop the AGC voltage must obviously be extracted before clipping, since after clipping the peak amplitude remains constant regardless of the input signal. Our aim is to keep the percentage of clipping as nearly constant as possible in order to avoid excessive distortion.



A hand wound version of the filter coil set. Winding data is given in the article.

Output from the second amplifier stage is at a convenient level for developing the AGC voltage and also for clipping. Sufficient AGC voltage must be developed to change the gain of the input stage over a range of 20 db. or so in order that the system can accommodate this change in level. Also, a minimum level is required for satisfactory clipping due to the curvature of the diode characteristics.

SHUNT CIRCUIT

For the clipping circuit itself, the well tried shunt circuit proved perfectly satisfactory. Bias voltages for the diodes are obtained from batteries in the simplest arrangements, but it is an obvious advantage if the batteries can be replaced by a divider network from the high tension supply.

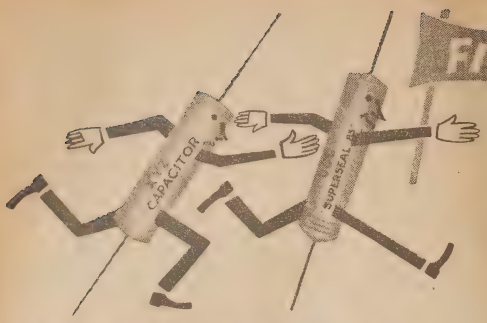
We did actually try a series type of clipper, and no doubt such a circuit could be made to work well. However, we gained the impression that some selection of components would be necessary for perfect balance.

The clipper circuit we have used is best worked into a high imperance load, and it is not practical to design a filter to work at the required impedance levels. Therefore, the clipper is followed by a valve, which acts as an isolating stage and impedance transformer.

FILTER COMPONENTS

Although simple enough on paper from well-known theory, a suitable filter circuit using components readily available presents serious practical problems.

We investigated the possibility of using the primary windings of speaker transformers. Small transformers have a primary inductance of the order of four henries with no DC flowing, making it necessary to design the filter or work at impedances of the order of 70,000 ohms. Losses are appreciable, and it is very difficult to find transformers with the required relative inductance values. The final result is that the filter does not have the required sharp cut off characteristic.



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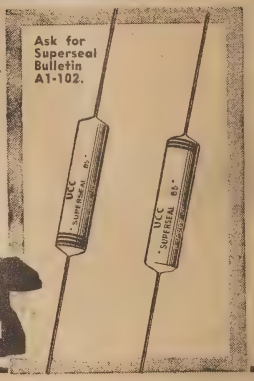

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We also considered that there are a number of standard air-core radio frequency chokes available as standard items throughout the trade. The difficulty here is that the maximum inductance available is quite small, making it necessary to work at very low impedance levels. This in turn presents problems in designing valve circuits to handle the required voltage output.

The best practical solution, then, appears to be either to wind your own inductors especially for the job or, alternatively, purchase ready-made inductors, when it is possible to work at the convenient impedance level of approximately 5,000 ohms.

CRYSTAL MICROPHONE

At this stage we suggest that you turn to the circuit diagram.

The input stage includes connections for a crystal microphone and feeds into a voltage amplifier. By far the most popular microphone for amateur work is the diaphragm type crystal. Inserts of excellent quality are available for two or three pounds and problems of hum pickup sometimes encountered with the various magnetic type microphones are rarely encountered.

Good quality micrphones of this type have a frequency response characteristic virtually level between about 50 c/s and 5,000 c/s and therefore can be considered to be flat within the range we intend to transmit. The output is lower than that of the so-called "communication" types. We generally design for full output with only 10 mV input in order to allow a small reserve of gain for distant speaking conditions.

In the present case, the 10 mV from the microphone has to produce sufficient ouput at the end of the amplifier chain to operate both the clipper and the AGC systems. The overall gain when the input is small and the AGC inoperative must therefore be very high. The usual problems of hum, noise and RF feedback encountered in speech amplifiers associated with transmitters are multiplied by the increase in gain of the system. The level is not so low that very special precautions need be taken, but it is as well to be aware that general care in the layout of components, etc., is desirable.

SHIELDING

The microphone insert should be completely shielded and preferably mounted in a metal case. Even an inch or so of exposed lead could pick up enough hum or RF to spoil your transmission.

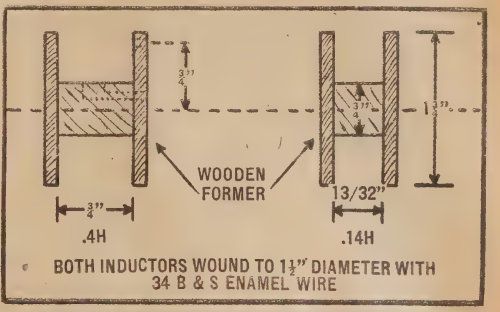
The 47K resistor in the grid circuit of the preamplifier should be physically small and mounted right at the valve socket, its purpose being to act with the input capacitance of the valve to form a low pass filter and reduce the possibility of RF feedback.

Bias for the EF86 is present under non-speaking conditions due to the high resistance in the grid return circuit and the plate current of the valve will not be greater than about 0.6 mA. As soon as the AGC circuit begins to operate additional bias is supplied and with a strong input signal the plate current is reduced to a very low value.

A coupling capacitor is required in the input in order to prevent the bias voltage appearing across the microphone. A larger value than .001 uF may be used if it is small physically. The effective load resistance for the mic. is 1 meg. and does attenuate the lower frequencies slightly.

The rest of the preamp. circuit is conventional except for the value of the screen bypass capacitor which is lower than normal. The object is to ensure that the screen voltage can increase quickly when the AGC voltage is applied. Otherwise there is a possibility of distortion on strong input signals

Six ounces of wire will be ample to wind both coils. The 0.4H coil has 5,000T approx. and the 0.14H coil 2,500T approx. They may be checked by resonance with a .01 uF capacitor. The frequencies should be 2,520 c/s and 4,270 c/s respectively.



Careful checks on the behaviour of the EF86 with AGC control were made and it was found that up to 25 db of control could be obtained with negligible distortion and up to 10V peak-to-peak output—more than is required in this case. Although the EF86 is not normally a remote cut-off type it behaves in this way because the screen voltage varies with the grid control voltage

Although we have not actually tried them, we see no reason why any other pentode preamplifier should not operate in a similar manner. The main problem you are likely to strike is that the noise and hum levels of the earlier types may not be good enough to work at the low levels. In any case, be careful to observe the usual precaution of returning all components, including the AGC bypass, to a common earth point near the valve socket.

Coupling to the next stage is via a small value capacitor and it is at this point that most of the low frequency attenuation takes place. A practical advantage here is that any hum picked up by the preamplifier is also attenuated.

The only reason for specifying a mica capacitor is that the value is likely to be reasonably accurate. It is often found that some of the high-k dielectric types are much higher than the marked value. We suggest that you experiment with the value of this capacitor for best results with your particular voice and microphone. The optimum may vary between about 220 pF and 1,000 pF.

GAIN CONTROL

The additional gain required for clipping and efficient AGC action is provided by the first half of the 12AX7. A gain control in the grid circuit allows for varying conditions. In most cases with the better quality crystal microphones it will be turned full on. With the poorer types which usually have a peak in the upper register and higher output, less gain will be required.

Part of the output from the 12AX7 plate is rectified by one half of a 6H6 Careful study of the circuit will show that there is a voltage delay arrangement to prevent AGC voltage being developed with very small signal inputs Actually, there is no AGC voltage developed until clipping starts the purpose of the AGC being to prevent too much clipping with its attendant distortion.

The control voltage is passed on to mic. preamp. via a diode wired with the polarity such that control is applied quickly after a strong input signal. However, it can only leak away via a very high resistance in parallel with the diode which takes some time. The overall effect is that the AGC follows the peak value of the signal and tends to maintain the clipping constant. The remainder of the AGC system consists of a filter to remove audio ripple from the control voltage. Note that the filtering is not sufficient for stability if the full value of coupling capacitor is used between the mic. preamp. and the 12AX7. If, for some reason, you wish to use values greater than 1,000 pF, more filtering will be required.

Preliminary experiments showed that the clipping action should take place at a level of about 10 volts peak-to-peak if curvature of the valve characteristic was to have no appreciable effect on the clipped wave. Constants of the divider network are chosen to satisfy this requirement.

SOURCE IMPEDANCE

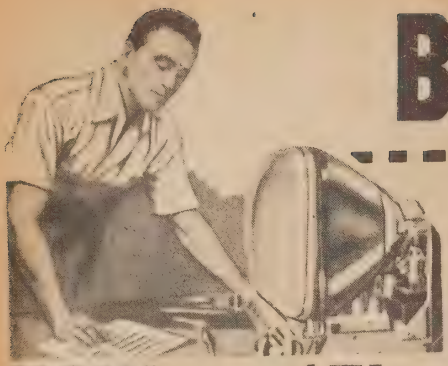
The clipper works best when fed from a high impedance source, hence the 0.47 meg. resistor in the coupling circuit. A high impedance load for the clipper is provided by the input of the cathode follower stage. Apart from the two 1,000 ohm resistors which should be fairly accurately matched, the circuit is virtually foolproof.

We did try germanium diodes and although preliminary results were not as good as with the 6H6, they could probably be made to work well. A germanium diode could be used in place of the AGC rectifier but the back resistance would be too low to allow it to replace the remaining half of the 6H6. Some of the new silicon diodes have very high back resistance combined with low forward resistance and could replace the 6H6 in both cases. The 6AL5 is also suitable and may be used without change.

One of the biggest problems in the design of the unit was to provide a low-pass filter with sufficiently sharp characteristics and to work at a suitable impedance level. After a careful review of the situation we came to the conclusion that none of the standard chokes, etc., could be put to effective use.

Furthermore, it was not reasonable to design a single section filter with sufficiently sharp characteristics. A classical filter for this application would con-

(Continued on Page 127)



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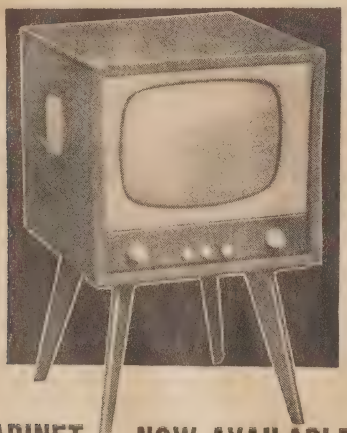

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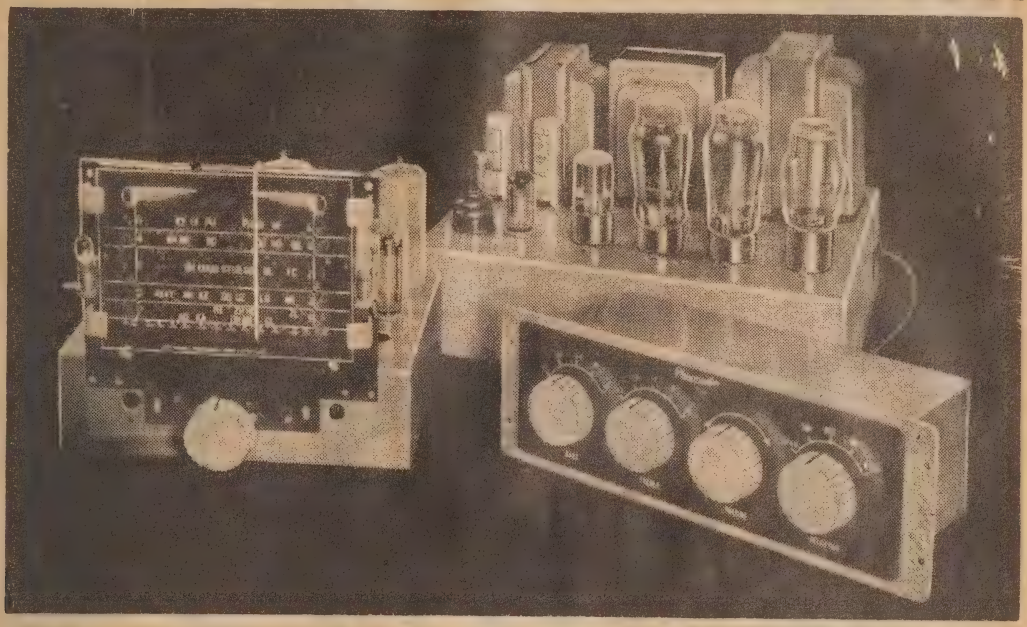

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FROM THE SERVICEMAN WHO TELLS

I suppose it was inevitable that the advent of TV would produce its own peculiar batch of fallacies, misconceptions, and groundless rumours on the part of the public. Yet, though I anticipated it, I must confess to being rather staggered by some of the fantastic stories I have encountered in the last few months.

IN some cases these are nothing more than the result of wishful thinking, plus some half-truths gathered from mangled Press reports, and are not likely to do anybody a great deal of harm.

Unfortunately, there is a more vicious form. I refer to stories either concocted or fostered by salesmen and others to suit their own ends. By reason of their origin, they have the ring of truth as far as the public are concerned, who are thus disposed to accept grossly erroneous statements as gospel.

The following are some typical examples I have collected over the past few weeks. I have taken the trouble to check their origin sufficiently to satisfy myself that they are quite genuine.

The first couple are what I classify as the wishful thinking type, and what better subject is there for this pastime than colour TV? The beauty of it is that it can be made to suit both sections of the community—those who own TV sets and those who don't.

TV COLOR SCREEN

The story for those who own TV sets is that one will soon be able to buy a simple screen to fit in front of the set and which (hey, presto!) will transform the black and white image into a colour picture like magic!

Unfortunately, no one is able to explain just how the colour information is to be conveyed to the image, or why it is that all other countries, including the U.S.A., has been unable to avoid a system so complex and costly as to be positively frightening—even in this day and age.

In fact, the teller of the story seemed to regard me as something of a spoilsport for raising such mundane matters. He wasn't concerned with the technicalities of the thing; all he knew was that it was on the way and, presumably, he intended to go on enjoying the anticipation of it.

Which is just as well, because he is unlikely to enjoy the reality!

Strangely enough, there is a basis for the story, even if it isn't a very logical one. Apparently some local bright boy decided that if we couldn't have genuine colour TV we could at least have an imitation variety.

Accordingly, he produced a screen divided into three coloured sections, running horizontally. I gather that the top section was coloured blue to represent the sky, the centre section green to represent the grass, and the lower section brown to represent the earth. (Or it may have been brown in the centre and green at the bottom. I forget which now.)

But, whatever the arrangement (and it seems the public were given a choice of combinations, there seems to be no satisfactory explanation as to how the various colours are expected to fit in with every type and variation of picture. I'm trying to visualise a pretty pop singer with blue hair, green face, and brown—er—throat. Somehow, the idea doesn't appeal.

Nevertheless, I understand that these devices enjoyed a surprising, if brief, popularity when first introduced, particularly in Melbourne. I can only assume that the Melbourne populace as a whole is more credulous than that of Sydney. Either that, or Melbourne has better salesmen.

THE GOOD OIL

For those who don't own a TV set the story has only to be changed slightly to suit their purpose. People who don't own a TV set are always on the lookout for a good excuse to conceal the fact that they can't afford one. When they run out of stock excuses, like the quality of the programs, the difficulty of making Little Willie do his homework, the adverse effect on the eyesight, etc., the possible advent of colour TV is an excellent backstop.

The usual story is that these people have inside information (quite confidential, of course) to the effect that colour TV is to be introduced into Australia in the next twelve months. Since this will automatically render all existing sets obsolete (they say), they don't propose to be caught with an obsolete black and white set on their hands. Far better wait a little while and take advantage of the new system.

The advantage of this reasoning is that it provides a multiple prestige boost. The teller has a logical face-saving excuse for not buying a TV set; he is obviously "in the know" concerning the TV industry, and he gives the impression that when he does spend money on a TV set it will be the best there is—regardless of cost.

Rather surprisingly, a percentage at least of these people honestly believe the story. One customer I encountered recently, a woman, was quite emphatic about the advent of colour TV. She knew someone who knew someone who worked in one of the large factories (quoting the same), and they were quite positive that this was so. She wasn't going to buy a black and white set, etc., etc.

LONG WAY OFF

I'm afraid my best efforts to convince her otherwise were of little avail. The best I can hope is that I have sowed the seeds of doubt and that she may realise her error a little earlier than otherwise.

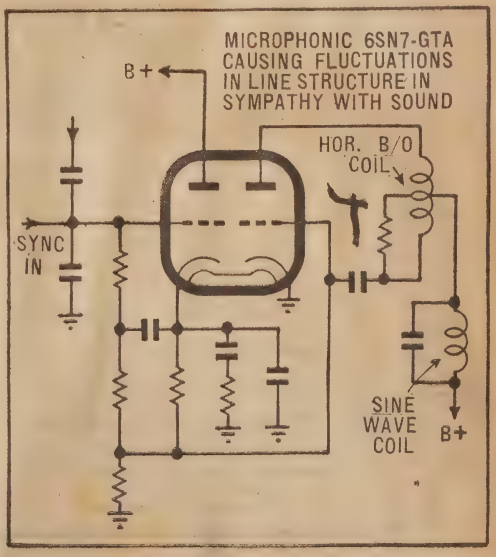
And what is the situation regarding colour? While prophecies have a habit of turning on their creator, I think the present position is fairly clear and is, briefly, as follows:

Colour is unlikely to be introduced into Australia for several years; certainly not less than five, more probably 10. By this time it is to be hoped that

☆

The popular "Synchro - Guide" type of circuit employing a 6SN7 as a combined line oscillator and automatic frequency control stage. Although normally very reliable, this one turned on quite an act when the valve became unduly microphonic. The effect was of displaced lines or groups of lines in step with the sound.

☆



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some of the technical and economic problems will have been solved, or even a complete new system evolved.

However, assuming that the system remains essentially as it is, apart from refinements, it is extremely unlikely that the introduction of colour will render existing sets obsolete, any more than it has done in the U.S.A. There the scientists who evolved the system went to a great deal of trouble to ensure complete "compatibility"—a word the Australian public will have to learn a lot more about in the future.

Briefly, this means that any black and white receiver can receive either black and white or colour transmissions equally well, though, naturally, the colour transmission is reproduced as a black and white image. Conversely, and fairly obviously, a colour receiver can receive a black and white transmission without difficulty.

As a result, the black and white receiver becomes obsolete only to the extent that it is not as good as the colour receiver; not because it is deprived of any transmissions. It will continue to provide black and white programs from any station until such time as the owner decides he wants to take advantage of the colour transmissions.

So much for the colour problem, except that I'd be willing to bet that in 10 years time people will still be putting off buying black and white sets because of the colour scare.

DEALERS' STORIES

Now I want to deal with the more deliberate type of fallacy: the type of story a dealer tells his customer because he is either too lazy or too ignorant to give them the true story.

The first concerned the matter of indoor aerials. A customer raised the point by asking my advice about indoor aerials in general and whether I thought an indoor aerial would be satisfactory in his particular case.

I pointed out that it was impossible to answer this question without an actual trial, and went on to explain some of the limitations of indoor aerials in general. I added that I thought he would probably find them something of a nuisance unless his position was extremely favourable.

Then came the prize question: "But will they harm the set?" (He seemed rather surprised that I hadn't raised this point.) Equally surprised that he had raised it, I replied that there was no suggestion of any damage to the set, and that it was purely a matter of performance in terms of picture quality.

SILLY STORY

"Well," he replied, "a relative of mine was assured by his dealer that the use of an indoor aerial was most detrimental to a set. He said that the set would probably not last more than three or four months before it would require attention, and would deteriorate rapidly. Naturally, he gave the idea away and settled for an outdoor type."

I'm afraid that statement rather rocked me, but my customer assured me that it was true. In fact, he had been there when it was made. In the light of that, I said I felt that the most charitable thing one could say about the dealer was that he was very ill-informed on the subject, while anyone with a suspicious nature might be pardoned for supposing that he wanted to sell an expensive outdoor aerial.

As far as that goes I have no special liking for indoor aerials myself. (I am excluding properly installed loft aerials.) It is only in the most favourable locations that they give good results, and are often extremely touchy both as regards their own position and the position of other metallic objects, such as venetion blinds. In addition, they often have to be reset for each channel, making just one more function which, if neglected, will degrade the picture.

But that does not mean that I would invent faults, just to sell a customer a more expensive aerial. Quite apart from any moral qualms I might have, there is the very practical point that, sooner or later, someone else is going to tell the customer the truth (as I was telling him now). When a couple more people also tell him the truth, he is likely to believe it, and the dealer's reputation suffers.

The next story, although on a different theme, bears a marked similarity to the previous one, at least as far as motive is concerned. This one came to me from a colleague, and concerned the reliability of a certain set, as queried by a prospective customer. The set was in the cheaper price range, but my colleague gave it as his opinion that it was a thoroughly reliable model and that he knew nothing to its discredit.

Then the customer told his story. He had been told by another dealer that all such sets were unsatisfactory, and gave as his explanation the fact that ". . . good TV sets use double valves which still work well after they have 'settled down' and lost about 30 per cent efficiency. In cheap sets this is not so."

Fooey!

THE TRUE STORY

It is true that many sets—in fact, most sets—use double purpose valves—twin triodes, triode pentodes, twin diodes, etc. —in the interest of economy. But, as far as the circuit is concerned, each section of such a valve is a separate unit performing a separate function. The fact that it has another set of elements in the same envelope is not going to make that particular valve last one day longer than if it was in its own separate envelope.

So, once again, I can only comment that the person making the statement was either extremely ignorant or had an axe to grind—and my bet is for the latter.

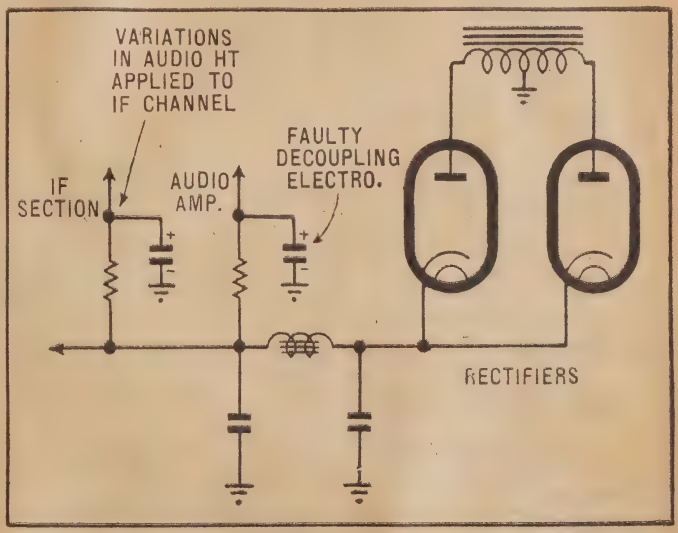
And the last one must surely be the daddy of them all.

It concerned the owner of a TV set who had had the misfortune to experience a picture tube failure. The serviceman made a few preliminary inquiries as to how the tube had failed, and then came out with his classic statement.

"A picture tube," quoth he, "should never be switched on for at least 15 minutes after switching off, otherwise it is likely to be damaged. The 15-minute period is necessary to allow the gas in the tube to settle back in the neck from the vicinity of the screen."

Well, you work it out.

Questions I would like to ask are: (1) What is this gas? (I always thought a picture tube was as devoid of gas as modern techniques could make it.) (2) What is its purpose? (3) In what manner is it supposed to protect the tube, anyway?



Another case of sound in the picture, this time due to common coupling of the audio amplifier and the IF and tuner stages through the power supply. A new decoupling electrolytic cured the trouble.

HOT AIR

What was the motive behind this story? In this case, I think, the serviceman was more foolish than malicious. Apparently he was not making an excuse to wriggle out of the tube guarantee, so it seems most likely that he was simply hard put to it to provide a satisfactory explanation for the failure, and said the first thing that came into his head.

I have struck plenty of fellows who make a practice of this. Their policy appears to be: Always give the customer an answer; tell him anything, logical or otherwise, as long as it sounds impressive, but never admit that you don't know.

One fellow I knew carried this to such extremes, that he made it a practice to "diagnose" any fault immediately the customer mentioned it. He did not need to see the set and usually had no more

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information to work on than the usual vague "My-set-won't-go-what's-wrong-with-it?" statement from the owner. Nevertheless, he would bark, "Faulty IF transformer," "Faulty converter valve," "Faulty loudspeaker transformer," etc., without the slightest hesitation.

Naturally, he usually had to resort to various subterfuges to "cover up" when the fault turned out to be something quite different—and more expensive—but this never seemed to worry him unduly.

Personally, I have never been able to see much sense in such a policy. Sooner or later such stories will backfire, to the detriment of one's reputation, while they don't seem to serve much purpose anyway.

Admittedly, the average customer may not be able to understand most technical explanations; but will he be any more satisfied with a false story than a true one? And, if not, isn't it better to tell the truth, have a clear conscience, and avoid any risk of repercussions later on?

TRUTH IN SERVICE

Even on those few occasions when the question cannot be answered immediately, surely it is better to admit to the fact than to try to cover up. After all, no one expects us to be clairvoyant, and few customers will regard it as unreasonable to suggest that, for example, a set or component be examined and tested before an opinion is given.

And, after that little bout of philosophy, perhaps we had better come down to earth and get around to the technical side of things.

It looks as though this month's article is to be an all-TV version, because the service faults I have to discuss also concern TV. More than that, they all concern the same symptom, even though due to different faults.

The symptom was sound bars in the picture, but with the qualification that this happened only when the volume control was advanced. The sound level necessary to produce this effect varied in all three cases.

The first was a commercial set, and when the customer complained of ". . . black lines that flickered with the music," I immediately conjured up visions of incorrect tuning or an IF strip which had drifted badly, the two most likely causes of sound bars.

EFFECT OF VOLUME

As a matter of fact, I was not immediately aware that the trouble was in any way connected with the volume control setting, even when I examined the set in the customer's home. It was only when I found it rather a strain competing with a cookery demonstrator, and turned the sound off, that we both realised that the bars had vanished.

I turned the sound up again; the bars returned. I turned it down, and they vanished. This put the fault in a completely different category and one which, quite frankly, I hadn't considered before. However, it was fairly obvious that I needed to check the audio system before worrying about IF alignment, a change of plans which did not distress me unduly.

A few minutes quiet thought about the problem, while I was getting the chassis out of the cabinet, suggested that changes in load created by the output valve could be finding their way back into the picture circuits, most probably through the power supply. If this were so, the most likely culprit would be the decoupling network feeding HT to the audio section, and in particular the electrolytic in this network.

With the chassis out of the cabinet and turned on its side, I commenced finding my way around the maze of components (isn't a strange chassis a frightening thing at first glance?) and eventually traced out the HT line to the audio section.

Having found the electrolytic I was seeking, I switched on again, advanced the volume control somewhat above normal, and then bridged it with a new one. I must admit it gave me quite a kick to see the bars vanish as I did so, particularly as the customer was watching.

A HOMEMADE TV

Number two was a home-made set, and the builder asked me if I would try to track down a peculiar jumpiness in the picture. My first impression on viewing the set was that it also had sound bars, but a more careful examination showed that it was actually a displacement of lines, to the right, occurring in time with sound peaks.

I'm afraid this one rocked me for a start. I had no snap diagnosis ready this time and spent several minutes trying to work out how sound variations in the HT line could thus effect the line oscillator. Even assuming that they were present, it was still hard to see how they could override the AFC system and cause such rapid changes in frequency.

We checked the wiring of this portion against the circuit, and could find nothing wrong. Then I prodded around the chassis and associated components in the hope that something obvious might show up. Something did, though not quite what I expected. It was the discovery that tapping the chassis also produced the effect, and was the first real clue.

I lifted the loudspeaker off the bench where it was resting alongside the chassis and watched the screen carefully. The trouble vanished, reappearing immediately I placed the speaker back on the bench.

It was now obvious that the trouble was mechanical rather than electrical, and most probably a microphonic valve. The most likely one was the 6SN7 line oscillator-cum-AFC stage. A few taps on the envelope showed it to be extremely touchy, and replacing it—the owner was fortunate in having a spare on hand—put the matter beyond doubt.

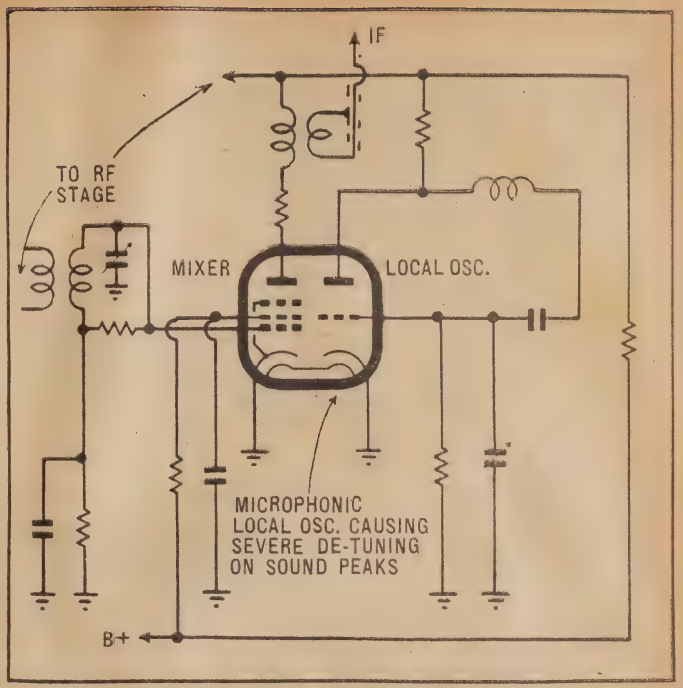
MICROPHONIC VALVE

In this case it seemed that the microphonic valve was causing the line oscillator frequency to vary in step with the sound. Since it was the actual oscillator valve that was involved, it would do this in spite of the AFC system.

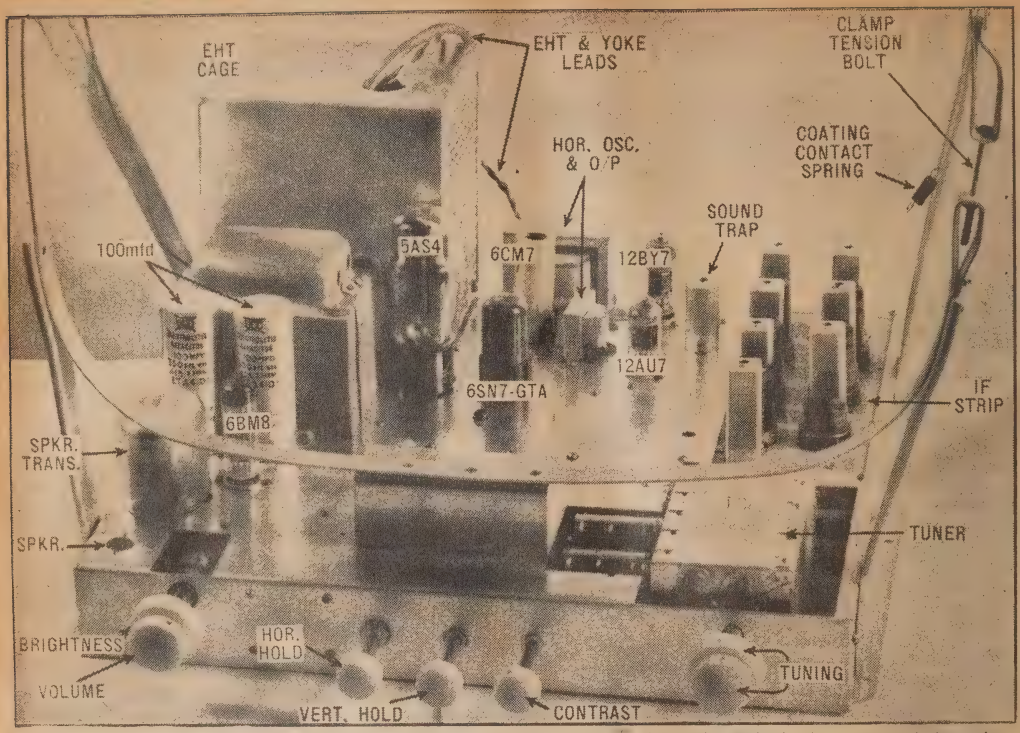
Number three was not really one of my own cases at all, though I was present on the job. A colleague from another suburb was kindly giving me a lift in his truck, and happened to mention that he wanted to stop by at a customer's house and try to track down a case of sound bars which varied with volume control setting.

When he added, "Have you any ideas?"

(Continued on page 123)



A microphonic converter valve in the tuner was the third cause of sound bars due to speaker volume. It is worth noting that, according to published data, a change of grid-cathode capacitance of only 1/1000 pf can produce a frequency shift as high as 15 Kc at 200 Mc. So a converter valve has to be good.



This coded top view of the chassis, seen through the picture tube supporting clamp, shows clearly the position of the major components. Note also the position of the commercial tuner and the additional cutout, suggested last month, to clear the two valves.

Our 21-inch TV Set - Part Two

Last month we presented the circuit and most of the descriptive matter for building a 21-inch television receiver. In this issue, further construction details are given for the EHT cage and mounting the picture tube. Information is given also regarding adjustment of the receiver for optimum performance.

DESPITE pressure on space, we managed to include in the last issue a couple of coded photographs of the EHT cage and indicated the steps necessary to assemble the major components on the metalwork originally intended for the 17-inch receiver.

We did this with a view to helping readers who may not have been prepared to wait for this second issue. In fact, a good many readers to our knowledge were already well under way with the main chassis and were only waiting on the deflection circuitry to complete the larger receiver.

The necessity to re-position a few components on the cage baseplate is only a minor nuisance, involving nothing more than a few minutes' work with a small drill and a rat-tail file.

In due course, we may have our draughtsman add the holes to make the plate suitable for either set of components, but quite apart from his preoccupation with other matters, it would take a while for the modified chassis to filter through to the actual user.

For the time being, at least, any chassis bought over the counter will need to have a few extra holes drilled, as indicated.

We shall assume, then, that the major components have been re-positioned and mounted temporarily in position. This will have involved trimming one mounting foot of the line output transformer.

by Neville Williams

recessing the EHT rectifier socket and mounting it on pillars. A new hole will have been drilled for the width coil, the drive capacitor located in position and mounting pillars provided for the sockets mounting the line output valve and damper diode.

As mentioned last month, the components to do with the B-plus boost circuit are centred mainly on a tagstrip mounted between the feet of the line output and EHT transformer. This strip can well be positioned and the required mounting holes marked when the unit is in its roughly assembled state.

In the original chassis we used an SM28 8-tag strip, with one end lug trimmed off, mainly because it was intended originally to have the B-plus boost filter components inside the cage. This is unnecessary, however, and the two components can more easily be mounted in the main chassis as suggested last month.

For this reason, the tagstrip indicated has more positions than are strictly necessary, but it is just as suitable as any other.

After all the major components have been fitted and their positions carefully noted, they can well be removed to facilitate the basic wiring, involving the tagstrips and, later, the sockets for the line output valve and the damper diode.

Leads can be attached to the tagstrips, along with the various resistors and capacitors, for subsequent connection to the major components and to the yoke socket.

You will find the wiring trickier than in any other section of the receiver and it will help matters if differently coloured wires are used for these flying leads and notes kept as to where they are ultimately to go.

FRONT TAGSTRIP

The tagstrip near the front of the cage carries most of the components serving the 6DQ6A line output valve. Apart from amended values, the wiring to this strip is much the same as for the 17-inch receiver and is indicated in the accompanying sketch (1).

This strip can be seen quite clearly in the photograph on page 67 of our last issue, being at the right of the picture. The 68 and 8,200-ohm resistors should properly be 2-watt types. We had 1-watt resistors in the cage when the picture was taken, only because the appropriate components were not to hand.

If 2-watt resistors are unprocurable when you buy your kit, the appropriate values and ratings can be approximated by using two 1-watt resistors, each half the value, in series, or two 1-watt resistors, each double the value, in parallel.

Actually, the two 1-watt resistors are still operating in the original set without sign of distress. However, it is one thing to over-run components in a prototype chassis, which is continually being "pulled about" and quite another in a chassis, which is supposed to work for long periods without breakdown, shut up in a cabinet.

Sketch (2) indicates the connections to the tagstrip previously mentioned, mounting between the feet of the line output and EHT transformer, and carrying the B-plus boost components. There is one small point to note about this strip also.

TWO CAPACITORS

At the time the set was built, we could not obtain a .033 mfd. 1,000V. capacitor and we substituted a .022 and .01 mfd. in parallel to make up the appropriate value. These were separately marked in the photograph on page 67 of the last issue.

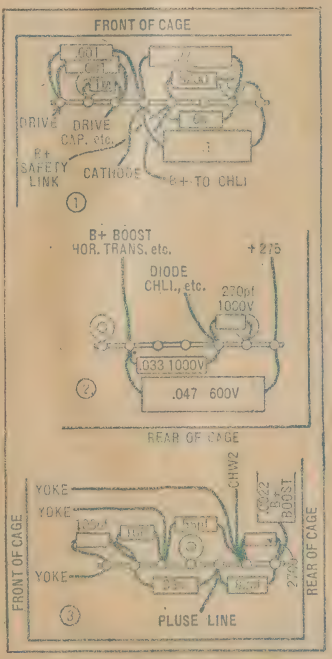
The third strip, illustrated in sketch (3), mounts alongside the line output valve and damper diode and more or less underneath the width coil, in its new position.

This strip carries the components shunting the yoke wiring and to do with the width and linearity coils. The peak voltages present in this portion of the circuit are substantial and call for capacitors having a very high voltage rating.

Those used in the original were ceramic types, developed for such applications and, fortunately, not very bulky. The ratings marked are those suggested by the marketers of the deflection kit and should be observed if complete reliability is to be realised.

Incidentally, in the circuit diagram we showed one capacitor as 83pF. The figure should read 82pF, in conformity with the preferred range of values.

In an emergency, lower voltage types could be pressed into service, but it then becomes a gamble as to whether they will break down or keep going indefinitely.



These small diagrams illustrate the connections which are made to the three tagstrips in the EHT cage. Strip (1) is near the front of the cage strip (2) between the feet of the line output transformer and strip (3) alongside the line output valve and damper diode.

Needless to say, the high peak voltages present also make it necessary to avoid contaminating the tagstrip with soldering paste, while the plastic covering on the hookup wire must be kept intact.

HORIZONTAL DRIVE

As will be evident from the sketch, three leads to the horizontal deflection coils can terminate on this strip, other leads making the necessary connections to width and linearity coils.

The horizontal drive capacitor can either be bolted or soldered to the angle bracket supplied for the purpose. Set the capacitor to minimum value, then mount it clear of the line output transformer and the tagstrip just mentioned, so that its adjusting screw is accessible through the hole in the rear of the cage.

With the basic wiring completed, and the line output and damper diode sockets installed, attention can be turned to the line output and EHT transformer and to the EHT rectifier socket.

As in the 17-inch receiver, the two resistors to do with the EHT rectifier filament were mounted inside the shrouded socket between blank base pins. The 1.5-ohm resistor was connected between pins 6 and 7, while the 2,200-ohm filter resistor runs between pins 7 and 4. This last pin, therefore, becomes the take-off point for the EHT lead.

You may be able to buy a 1.5-ohm resistor over the counter, but, if not, it can be made up by winding a length of wire from a jug element around a small resistor.

Both resistors should be kept very close to the socket pins, to minimise the risk of corona discharge to the surface of the chassis underneath.

Connecting the filament wires from pickup loop to socket calls for considerable care. Our suggestion is to drill a couple of holes in the skirt, about half an inch apart and half an inch from the bottom, on the side facing the transformer. A third hole can be drilled nearby for the EHT output lead.

ATTACHING LEADS

The transformer and socket should be held in place and their relative positions noted. Now turn them upside down, trim the leads, pass them through the holes and solder.

For the EHT lead ordinary hookup can be passed through a length of plastic tubing. Alternatively, the braiding can be stripped off a length of small diameter coax. cable or plastic mic. cable and the outer sheath replaced, to give a doubly insulated inner conductor.

With the leads duly attached, the EHT rectifier socket and transformer can be turned the right way up and mounted permanently on to the baseplate, taking care not to fracture the joints just made or to strain unduly the pickup loop.

The EHT lead must ultimately pass up through the hole in the top of the cage and to the Ultor socket on the side of the picture tube. Proper shrouded clips are available for connection to the Ultor, though some constructors have used nothing more ambitious than a safety pin minus the clasp and with the ends turned outwards to grip the inside of the contact hole.

With the line output transformer in position, most of the basic wiring can be completed, leaving only the width and linearity coils to be installed.

The width coil intended for the 21-inch deflection kit differs from the 17-inch type in that the new one has two distinct windings, one shunting portion of the line output transformer and the other in series with one lead to the yoke.

COIL CONNECTIONS

Winding the core through its travel progressively decreases the inductance of the shunt coil and increases that of the series coil, thereby reducing picture width. Screwing the core the other way has the opposite effect.

Connections to this coil must obviously be the right way round for it to function correctly and the accompanying diagram gives all the necessary information.

There appears to have been some inconsistency between published data and

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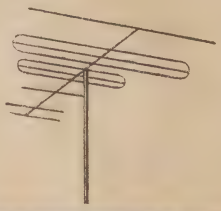

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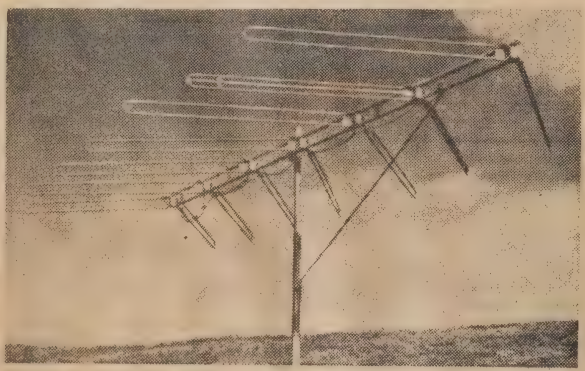

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the coils actually released. Our own diagram is correct, as far as we can establish, but the constructor would be wise to double-check the connections, as they are made, by inspection and by a measurement of resistance.

The common connection, which should be obvious enough, must go to lug 1 on the line output transformer.

The connection to the larger coil, having a quoted resistance of 13.6 ohms, goes to lug 2 on the line output transformer.

The smaller coil, having a quoted resistance of 3.84 ohms, connects in series with the lead to the yoke

Because of its double function, this type of width coil gives excellent degree of control and constructors should have no difficulty in suiting the picture to their own ideas — either accurately framed or overscanned by a deliberate amount, as is common practice in commercial receivers.

17-INCH RECEIVER

In the original 17-inch receiver, using a CHW1 width coil, the range of control is not as great and some constructors found the picture being overscanned to more than their liking, even with the control set for minimum width

Observing the effectiveness of the CHW2, we wired one into a 17-inch receiver, replacing the CHW1 and using the same method of connection as for the 21-inch receiver. It afforded adequate control, allowing the picture to be framed accurately in the mask at an intermediate setting of the core.

The same damping components across the smaller coil appear to be adequate to suppress ringing. The two components in question are the 2,700-ohm 2-watt resistor, and the 0022mfd. 1,000 volt capacitor

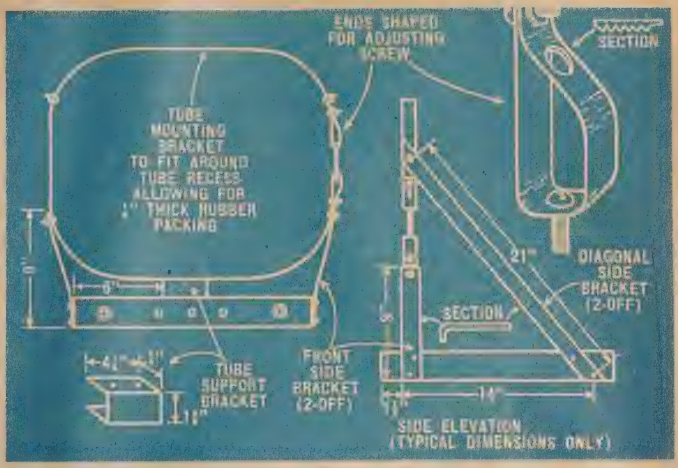
Because of its reaction on the line output valve, installation of a CHW2 in the 17 inch receiver may necessitate resetting the linearity and horizontal drive adjustments.

The linearity coil, CHL1, is the same as used for the 17-inch receiver It is only a single winding and polarity would not appear to be significant to its operation. However, the original published specifications suggest that the start of the winding connects to B-plus and the finish to the damper diode through the suppression choke.

Start and finish of the winding can be determined by inspection.

The linearity coil carries a spare lug, which is handy, in that the 1.5 uH choke can bridge to it from the finish of the winding, a lead running away from this point to the damper diode anode.

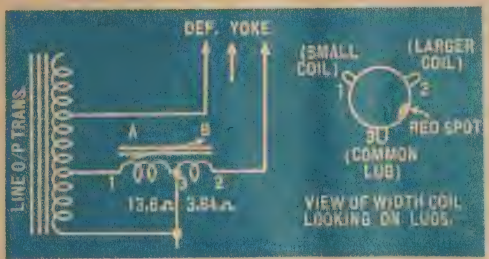
SUPPORT BRACKETS FOR TUBE



This diagram illustrates a simple method of supporting the picture tube, using materials readily available to the home constructor. Precisely the same method could be used to support the tube for the 17-inch receiver.

This lastnamed component is sometimes referred to as a "spook suppressor." Like the 2.2K resistor in the EHT output circuit, it is a precaution against spurious oscillatory effects which can apparently occur in the line output and EHT circuitry. These allegedly produce an odd transverse line across the picture.

Leads from the deflection circuitry pass up through a hole in the top of the cage to a good quality octal socket, where they are joined by the vertical deflection leads coming up through the chassis The leads should be snipped off and soldered to the respective socket pins, leaving sufficient length only to permit the cage cover to be lifted away, should this be necessary at a later date.



Here is the essential data for connecting the new width coil into circuit. The same width coil can be substituted in the 17-inch receiver to give rather better control than the original single-coil unit.

The deflection leads should not be made longer than necessary and must be kept away from the vertical oscillator and output valve. Failure to observe this requirement can prejudice or cancel interlace.

We also noticed an effect on interlace if the video signal lead, passing to the cathode of the valve, was allowed to run along the neck of the picture tube This lead also should be kept as short as practicable and in the clear.

Beneath the chassis, voltages to the cage come from the terminal panel depicted last month. It is important that the B-plus circuitry be passed through the safety link on the yoke socket so that the line and frame output valves cannot operate unless the yoke is connected.

Completion and installation of the cage should finish the electrical work on the chassis and testing could conceivably proceed with the tube propped up on the bench alongside. However, this is a rather dangerous practice and, if the tube is to be mounted on the chassis, it may as well be done initially as afterwards.

The picture and diagrams give a good idea of how this can be done, but a few words of explanation may be of further assistance.

According to manufacturers' instructions, the clamp around the face of the tube should not be wider than three-quarters of an inch and a visit to a hardware store brought to light a standard aluminium beading of this width and the section indicated on the accompanying diagram.

FORMING CLAMP

One end was bent over as indicated, leaving clearance to receive a 3-16th inch Whitworth nut. Then, with another pair of hands (and arms) cradling the tube, the beading was bent carefully around the face. This involved all but a few inches of the 6ft length, by the time a little slack was allowed for the packing rubber and the end bent over to form a socket for the clamping bolt.

A clearance hole in one socket will allow the bolt to pass through and also give access for a screwdriver to engage the slot in the screw head.

Having formed the clamp, lock it on to the tube face with the rubber in position, check it for accurate shape and note how much of the clamping bolt has passed through the nut. The rubber, by the way, is 1 x 1-8th inch sponge strip.

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413	330uh video choke	3/4
414	TV noise filter. 2amp	3/4
415	3uh damper diode choke	3/4
416	43uh TV noise filter. 3 amp	3/4
417	82uh ratio choke. 1½amp.	IC 3/4
418	10uh video r.f. choke	3/4
419	22uh video r.f. choke	3/4
420	27uh video r.f. choke	3/4
421	33uh video r.f. choke	3/4
422	39uh video r.f. choke	3/4
423	56uh video r.f. choke	3/4
424	68uh " "	3/4
425	82uh " " "	3/4
426	100uh " " "	3/4
427	220uh " " "	3/4
428	270uh " " "	3/4
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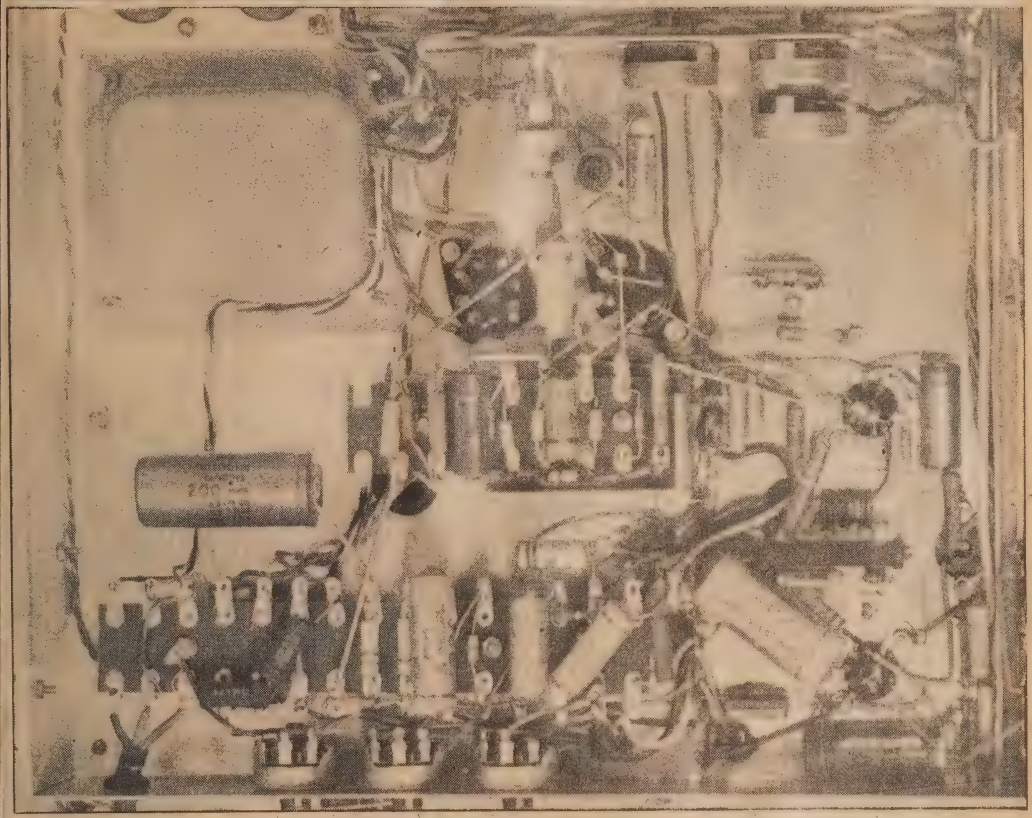
CLOSE-UP VIEW OF VIDEO, DEFLECTION WIRING



This somewhat enlarged view of the video and deflection wiring may usefully supplement the general underneath picture given last month. Note the shield which separates the line frequency components from the frame oscillator stage.

At this stage the clamp can be removed from the tube the tube put away and the clamp screw tightened again to the same setting as with the tube in position. If handled carefully, the clamp should retain quite accurately the shape of the tube face.

Next make up a U bracket from steel or 16-gauge aluminium, to the dimensions indicated, and attach to the chassis It will not be exactly central, having to clear the cutout mentioned last month for the commercial tuner. The distance from the front of the chassis is typical but may need to be modified according to your ideas on cabinet design, mask position and so on.

THE U-BRACKET

Having positioned the U bracket, attach the tube clamp beading to it, centring the beading over the chassis. Use countersunk screws and packing washers where necessary, to adapt the curvature of the clamp in the U bracket.

The clamp is locked to the chassis with the aid of another length of aluminium beading, preferably a rather wider and stronger type. The section of the beading used in the original is illustrated, being about 1 1-8th inch wide. Its position relative to the chassis is obvious from the drawing.

The finished bracket work is very strong and the chassis can readily be rolled on to its side with the tube in position.

The tube is supported purely by the face clamp and, in fact, the manufacturers specify that the base socket be not supported other than by the tube.

To earth the outer conductive coating, we drilled a couple of holes in the sloping support brackets and angled so that a wire stretched between them would pass across the coating clear of the Ultor connection. The "wire" is a length of copper braiding held taut at one end by a light spring.

When the tube is ultimately put into operation a substantial charge is built up on and between the inner and outer coatings. This cannot be dispelled by merely flicking a wire between the Ultor terminal and "earth." Because of the nature of the coating, the charge builds up again after discharge, or even after several discharges.

One can, therefore, easily get a shock when handling the tube. In itself, it is not dangerous, but reaction to it may cause one to mishandle the tube, with dire consequences.

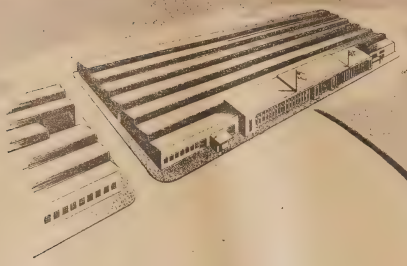
With the tube in position, the yoke can be passed over the neck, with the input leads at the bottom. It can be held forward conveniently by a disc of bakelite or plywood slipped over the neck after it and held forward by a couple of springs to the side brackets.

The centring magnet clips on to the neck just behind the yoke, while the ion trap is positioned near the base. The ion trap should be positioned initially so that the magnet block is about in line with pin 12 on the base and with the red spot downwards and adjacent to pins 9 and 10. It should be about ¼ to 3-8th inch from the bakelite base. This is for the 21ALP4-A picture tube specified in the circuit.

PICTURE CIRCUITS ONLY

The wise constructor will already have checked the receiver's ability to tune sound on all channels so that, when switching on with the picture tube in position, only the picture circuits will be in immediate need of checking. Better still, if a CRO is available, the deflection oscillators can usually be set on frequency before the tube is connected.

On switching on, with the picture tube in position, the screen should be watched in a darkened room, with the brightness control at about half setting. If the ion trap has been positioned as described, the chances are that a raster will appear on the screen immediately.



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If no raster appears, move the ion trap magnet slightly around the suggested position, watching for any sign of illumination. Once the raster is seen set the ion trap initially in the position which gives the brightest trace. If no raster appears, advance the brightness control a little more and try again.

Failure to observe a trace might indicate that there is no EHT on the tube. If no EHT voltmeter is available, a rough but nevertheless useful test is necessary.

Securely earth one end of a test lead to the chassis and bring the prod slowly toward the Ultor clip (with the shroud rolled back if fitted). At about ¼in there should be a sharp spark or arc, not unlike that from a magneto or ignition coil.

LACK OF EHT?

Absence of EHT obviously indicates a fault, which will have to be traced before further progress can be made.

Illustrated in the photograph opposite is an alternative type of picture tube, which can be regarded in this receiver as a direct substitute for the 21ALP4-A. From the Philips and Mullard range, it is designated as type AW53-80.

Examination of the characteristics indicates slight electrical differences, the most obvious being the heater current rating, which is of no significance in a parallel network. The base connections are the same except that pin 7, which is blank for the 21ALP4-A, has an internal connection for the AW53-80. No external connection should therefore be made to it.

The AW53-80 was delivered to us with its own ion trap magnet attached but apart from using this ion trap instead of the MSP variety, we simply substituted the tube directly for the 21ALP4-A. Since it will operate with the same EHT and requires the same deflection angles, the deflection components specified in the original circuit suit equally well. Likewise the centring magnet.

Published data for the AW53-80 lists the following procedure for setting the ion trap magnet supplied with it.

Slip the magnet assembly on to the neck of the tube with the arrow facing AWAY from the screen. It should be on the side diametrically OPPOSITE the line marked on the tube neck, which line is normally adjacent to the pin 3 position.

SETTING ION TRAP

With the centring magnet set for zero effect (arms together) and the brightness advanced just sufficiently to give a moderately bright raster, push the ion trap toward the screen until the brightness just begins to decrease noticeably. Note or mark the position of the magnet, then push it toward the base until the same decrease in brightness is evident.

Position the magnet midway between these two extremes, then rotate it slightly one way and the other around the neck and leave it in the position which gives maximum brightness. Lock the magnet in position and earth to the chassis.

The Mullard Technical handbook gives rather more detailed information than this but the foregoing is sufficient for all practical purposes.

By the same token, the remarks given earlier re setting the ion trap for the 21ALP4-A can be supplemented by reference to data in "Radiotronics" as reprinted in our August issue.

So much for the actual picture tubes.

With a raster on the screen and the set tuned to an active channel, the Hold controls can be adjusted. The Frame Hold should present no difficulty and should stop the raster from rolling, even though the picture may not be composed horizontally.

If the Frame Hold does not lock immediately, try varying the Fine Tune, because optimum tuning for picture lock and quality is not necessarily the setting one might choose by listening to sound only.

Having set the Frame Hold, the next step is to set the Line or Horizontal Hold. This may come immediately within range of the potentiometer but, if not, set the potentiometer at about mid position and, with the fingers, wind the core in the horizontal oscillator coil through its travel.

PICTURE SHOULD LOCK

At some setting, the picture should suddenly lock. If it doesn't, screw the core in the sine wave coil a couple of turns one way or the other and try again. This preliminary adjustment should at least give the satisfaction of seeing a stationary picture.

Actually, the setting of the sine wave coil should be determined with the aid of a CRO clipped on to the end remote from the 68K supply resistor. With the picture locked normally, the core should be set so that the waveform has the general appearance indicated on the circuit, the rounded portion being about 15 per cent less in height than the peak.

No trouble should be experienced in reproducing the shape on a wide-range CRO or even one with a response to 200 or 300 Kc. With an old-style audio type, the peak will not be so clearly defined and some allowance must be made for this.

If no CRO is available, something like optimum circuit conditions can be achieved by the following procedure; Short out the Sine Wave coil, set the Line Hold potentiometer at about mid position and adjust the core in the horizontal oscillator coil till the picture locks normally. Using a test pattern for preference, adjust the core and, if necessary the Line Hold potentiometer within its operating range, till the vertical lines are steady and as straight as possible.

Now, leaving these two adjustments strictly alone, remove the short from the Sine Wave coil and adjust its core to produce or preserve steady and straight vertical lines, with reliable line synchronisation.

The chances are that, at one extreme setting, vertical lines will be wavy. At the other, lines will be straight but the receiver will not lock instantly when switched from channel to channel. Having selected a suitable compromise setting, the two cores can be left set and any possible locking function thereafter controlled by the Line Hold potentiometer.

It is possible that a whitish line may be seen down the picture somewhere near the centre, and this would indicate excess drive to the line output valve. Insert a screwdriver through the rear of the cage and tighten the screw in the drive control trimmer until the line just disappears.

The next step is to trim up the picture dimensions and linearity, and failing a suitable pattern generator, the best idea is to work on station test patterns. Both line and frame circuits have to be adjusted and it matters little in which order they are done. You'll probably want to double-check them, anyway.

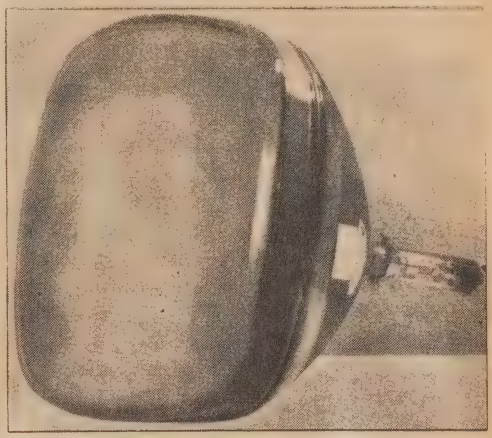
As mentioned in connection with the 17-inch receiver, the frame height and linearity controls are highly inter-dependent and the names could just as easily be interchanged.

HEIGHT, LINEARITY

You will find that the simplest process is to set the Linearity control at about half rotation and adjust the Height control to fill the screen. Have a look at the shape of the circle and note whether the top or bottom is obviously compressed. It is also easy enough to note compression or expansion of the trace by examining the separation between scanning lines.

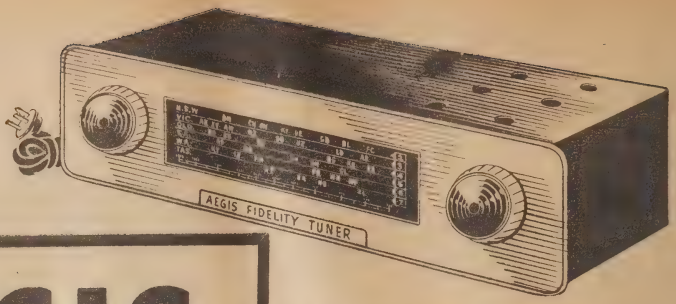
Having noted the general shape of the circle, etc., rotate the Linearity control by, say, 30 degrees in a specific direction—clockwise or anti-clockwise. Reset the Height control and see whether the overall linearity has improved. If it has, make a further adjustment in the same direction; if it has worsened, reverse the procedure.

You may be hard put to it to avoid some slight compression or stretching at the very extremes of the picture, but



As an alternative to the 21ALP4-A picture tube, this Philips or Mullard type can be regarded as a direct substitute in the R, TV and H receiver. Like the 21ALP4-A, it uses electrostatic focus and has an aluminised screen, ensuring high picture brightness. It is supplied with its own ion trap.

AEGIS FIDELITY TUNER (Mark 2)



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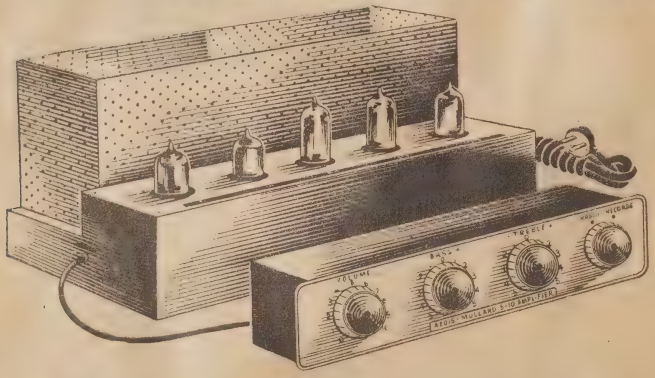

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gross error indicates the need for more careful adjustment.

The width of the picture is directly controllable by the Width Coil and its effect will be obvious enough.

The effect of the Linearity coil is more obscure and may not be obvious except on a test pattern. It tends to produce or to cancel close grouping in a vertical direction in certain regions of the picture. The best plan is to try to observe the effect as the core is wound through its travel and to choose a setting which appears to be optimum.

SETTING WIDTH

It may be necessary, after such adjustment, to reset the Width control. A large mirror, supported in front of the chassis, will save a good deal of dodging around during these adjustments.

In order to keep the picture accurately framed and centred, while working on the line and frame circuits, the centring magnet may have to be manipulated from time to time. When the two arms are together, the magnet has very little effect. When they are diagonally opposite, the effect is greatest and the beam will be deflected to a maximum in one direction.

Setting the arms at various angles in between and rotating the whole assembly on the neck, will deflect the image in various directions and to varying degrees. It is easier to observe the action than try to explain it. The limit to the adjustment in any given direction is reached when manipulation of the magnet causes a shadow to appear on portion of the screen area.

In setting up the receiver be guided by all the patterns and pictures offering but be the slave of none. Over and above the possible effect of signal strength on the receiver itself, noticeable inconsistencies seem to occur at transmission in respect to framing and other scanning details and the right settings are those which give good average results on all signals.

You will find that adjustment of the Line Hold control will move the picture bodily from side to side, as also will manipulation of the core in the line oscillator coil. This is normal and it is logical to centre the picture with these controls in their usual positions.

SHUNT CAPACITOR

The position of the picture on the screen is also affected by the 15pF capacitor across the 0.15M resistor in the line oscillator control valve — the first half of the 6SN7-GTA. The capacitor was not included in the 17-inch receiver but experience has shown that a bypass of up to 100pF in some cases will improve synchronisation and assist in centring the picture on the screen. It is a point which can well be subject to experiment.

You will note also that we have increased to 3.3M the resistor in series with the frame linearity control. Experience showed that best linearity was achieved in many receivers with about 4 megohms in circuit, the present network giving a range of adjustment from 2.5 to 5.8 megohms.

So much for the picture "geometry."

Picture brightness and contrast are controllable by knobs at the front provided for the purpose and both need to be set in relation to one another and the general light level in the viewing room.

Have the picture bright enough for comfortable viewing but not so bright that the highlights tend to flicker, particularly when you are not looking right at them. Set the contrast control to a position which gives good balance in the photographic sense on an ordinary scene. There will normally be some black parts in most pictures but the contrast is too far advanced if a little less contrast or more brightness reveals detail in seemingly black areas.

Instructions relating to the tuner are normally available with it, so that reiteration is not necessary here. The tuning on each channel should be adjusted, however, so that towards one extreme the fine tune control sound bars appear across the picture. At the same time, a fine serration may be evident on the lines, due to the 5.5Mc beat component between the two carriers.

The correct tuning position is just clear of the sound bars and 5.5Mc pattern, at which point outlines should be sharp and dark areas adequately filled in. If dark areas can only be filled in well away from this point, or if the picture suffers from fringe and halo effects, there is a strong chance that the IF alignment needs attention.

B-PLUS BOOST

Reverting to the frame circuit for a moment, the constants quoted in the B-plus boost filter give a supply voltage to the frame oscillator and output stage of 500. This is filtered by a 16mfd. 600PV capacitor.

No trouble was experienced with this capacitor in the original receiver, but we have heard of one or two cases where the capacitors have broken down.

One obvious way out of the difficulty is to use two 32mfd. 350-volt types in series to give an effective 16mfd. with higher working voltage rating than is feasible with a single electrolytic.

On a test run for several hours, two electrolytics connected in this fashion gave no hint of trouble, the voltage dividing up between them in quite accurate fashion. However, a simple method of stabilising the voltage exists, in that the junction of the two electrolytics can be pointed to the main B-plus line (275V) with a resistor of about 56K. This will hold the junction to this potential and ensure that the voltage across each electrolytic will remain within its rating, notwithstanding any difference in leakage which might develop.

Some designs show the B-plus boost bypass simply returning to the B-plus line, but, in our own receiver, we found that this produced rather unstable operation of the frame circuit.

An alternative and electrically logical return point is to the cathode of the frame output valve. Connecting the 16mfd. from the B-plus boost line to this cathode provides a direct return path for the circulating frame deflection current. What is more, the potential across the electrolytic is reduced by the 55-odd volts at the cathode, bringing operation well within the rating of a 600-volt electrolytic.

The alternative return point appears to have no effect whatever on the frame circuit operation and, in point of fact, it will probably make the cathode bypass less critical, since it is no longer in the plate return path.

From our checks on the boost circuit it would appear that the 16mfd. as specified is the minimum value which can be used as a filter. Lower values tend to introduce shading and curvature of vertical lines. If a higher value can be used as, for example, a 24mfd. 600V type it would be all to the good.

So much for the chassis itself and adjustments thereto.

To date we have not had the opportunity to design and construct a cabinet for the receiver, but it should not prove an unsuperable problem for the resourceful home constructor. If a simple cabinet is required, it could be constructed along the same general lines as the one suggested for the 17-inch receiver, being scaled up to house the larger tube.

Since the tube is mounted on the chassis, no special support members would be needed, simple cleats being used to hold the safety glass and mask in position. Nowadays, most readers will prefer to buy a ready-made mask rather than try to fashion one themselves.

The same combination of knobs can be used, as for the earlier receiver. Two large knobs are required for brightness and fine tuning, being drilled or filed to fit the shafts. Two medium-sized knobs, one bushed, serve for volume and channel selection and three small knobs for the centre controls.

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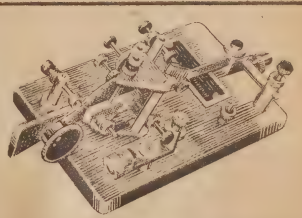

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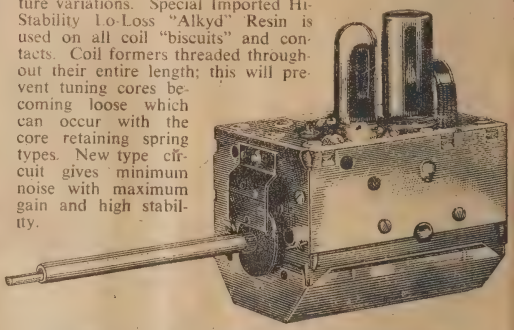

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Refer Jan. '57 R. TV and H. Page 56 for a suitable circuit and Constructional Data.

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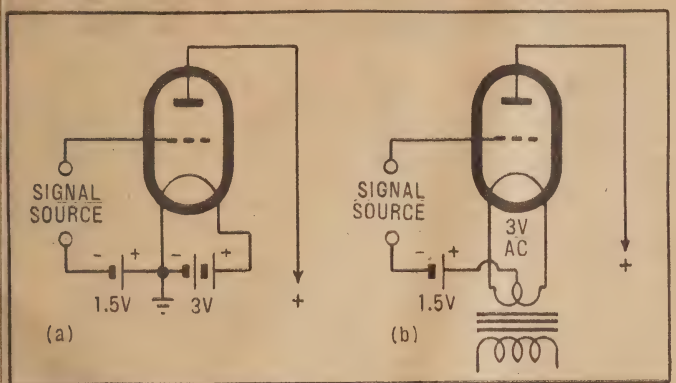

Figure 1: In a battery valve, potentials are normally reckoned in respect to the negative filament pin, as in (a). Early attempts to use directly heated valves with AC on the filament involved the use of a centre-tapped filament circuit as in (b).

How Receivers work from the AC Mains

For the sake of simplicity, most of the circuit discussion to date in this course has assumed the provision of suitable filament, bias and high tension voltages, without much emphasis on how such voltages are obtained. In this instalment, we explain how supply voltages are derived from the AC power mains in an ordinordinary domestic receiver.

In the early days of radio, receivers were invariably supplied from batteries. It was commonplace to use either an accumulator for the filament supply or a number of heavy-duty dry cells capable of supplying the requisite and often considerable filament current.

The grid bias voltages were taken from a special bias battery, not intended to deliver significant current, but with tappings at each cell junction to give voltages in 1½-volt steps to 4½ volts or 9 volts — to quote a common figure.

RADIO B-BATTERIES

For the high tension supply, radio "B-batteries" were used. These were large and rather expensive banks of dry cells, usually made up in 45-volt blocks and tapped at 22½ volts. Two such B-batteries in series could supply 90 volts, while three in series were commonly employed to give 135 volts.

While the early sets were simple enough from the designers' point of view, the need to provide and attach and conserve batteries was a constant worry to radio set users and it was natural that efforts should be made to cut the operating costs, at least.

As a result, various gadgets appeared aimed at supplementing or replacing the expensive batteries.

Numerous chargers or "trickle chargers" were put on to the market for radio accumulators. The chargers might deliver currents up to 3-odd amperes and would top up a failing battery in a day or so. Trickle chargers were designed to be left on more or less continuously, keeping the battery full at all times and saving the hitherto regular trip to the local garage for a battery re-charge.

So-called "B-Battery Eliminators" were released to replace the high-tension batteries altogether. These incorporated transformer, rectifier and filter system, rather like a modern AC power supply. Various resistors and tapping points were included so that they could supply the requisite intermediate voltages at the order of current drain commonly encountered in battery sets of the day.

Some B-battery eliminators also included auxiliary circuits to provide negative bias voltages, although the cost of a bias battery was never a major item.

These various units enjoyed a limited degree of popularity, but the obvious objection to having gadgets and accumulators attached to the family radio provided strong incentive to produce receivers which could simply be plugged into the power point and operated therefrom just like any other electrical appliance.

Initially, the main difficulty was that of providing filament supply. For reasons we shall see a little later, AC from the power mains cannot readily be changed to DC at the voltage and current needed to operate a number of parallel-connected filaments.

There were — and still are — two basic objections to applying AC to valve filaments.

The first and obvious one stems from the fact that the plate current of a valve is controlled substantially by the voltage present between grid and filament, this voltage being the sum of:

(1) The voltage along the filament itself;

(2) The deliberately applied negative bias, and

(3) The input signal voltage.

FILAMENT EARTH

Consider the basic circuit shown in figure 1a. Following common practice, the negative end of the filament is earthed, forming the reference point from which other voltages applied to the valve are reckoned. Thus, nominally, the valve would be operating with a negative grid bias of 1.5 volts.

In point of fact, however, this figure of bias only applies between the grid and the negative end of the filament. As far as the other end of the filament is concerned, the bias is really 4½ volts, being the difference between minus 1.5 and plus 3.0 volts.

The average of mean bias effective at the centre of the filament must obviously be the sum of the applied bias plus half the filament voltage—in this case a total of 3 volts—and the plate current assumes a certain value as a result.

If the filament battery were to be reversed, so that the negative end of the filament and the positive side of the battery were earthed, the effective bias between grid and the earthed end of the filament would still be minus 1.5 volts. However, the grid would be 1.5 volts positive with respect to the other end of the filament and the average or mean bias from grid to the centre of the filament would be zero!

As a result, plate current would be greater than with the normal battery connection.

It follows that, if the effective bias and, with it, the plate current, changes when the filament battery is reversed then application of an alternating potential to the filament would cause the plate current to vary at 50 c.p.s. This alternating plate current would be heard in the output of the receiver as an intolerable hum, over and above the desired signal.

TAPPED WINDING

The effect could be cancelled partially by supplying the filament from a source of alternating voltage with its centre tapping point earthed, as in figure 1b. In this way the average potential of the filament with respect to grid would re-

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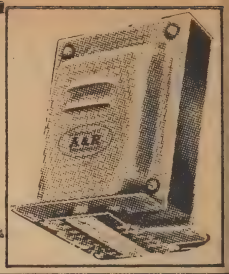

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Type	D.C. mA	Prim. Volts	Sec. Volts.	Filaments
1763	100	200 — 230 — 240	300-CT-300	5V-2A; 2 x 6.3V — 2A
1764	,,	,, ,, ,,	325-CT-325	,, ,,
1765	,,	,, ,, ,,	385-CT-385	,, ,,
1766	125	,, ,, ,,	285-CT-285	,, ,,
1767	,,	,, ,, ,,	300-CT-300	,, ,,
1768	,,	,, ,, ,,	325-CT-325	,, ,,
1769	,,	,, ,, ,,	350-CT-350	,, ,,
1770	,,	,, ,, ,,	385-CT-385	,, ,,
1771	150	,, ,, ,,	285-CT-285	5V-3A; 6.3-2A; 6.3-CT-2A
1772	,,	,, ,, ,,	325-CT-325	,, ,,
1773	,,	,, ,, ,,	350-CT-350	5V-3A; 6.3-3A; 6.3-CT-3A
1774	,,	,, ,, ,,	385-CT-385	5V-3A; 6.3-CT-3A; 2.5-5A
1775	150	200 — 230 — 240	385-CT-385	5V-3A; 6.3-3A; 6.3-CT-3A
1776	175	,, ,, ,,	285-CT-285	,, ,, ,,
1777	,,	,, ,, ,,	325-CT-325	,, ,, ,,
1778	,,	,, ,, ,,	350-CT-350	,, ,, ,,
1779	,,	,, ,, ,,	385-CT-385	,, ,, ,,
1780	200	,, ,, ,,	350-CT-350	,, ,, ,,
1781	,,	,, ,, ,,	400-CT-400	,, ,, ,,
1782	,,	,, ,, ,,	450-CT-450	,, ,, ,,
1400	250	200 — 220 — 230 —240V	565-500-425 a side	2 x 6.3V-3A; 5V-3A 2 x 2.5V-3A
1371	300	,, ,, ,,	1000, 850, 750, 600, 500 a Side.	

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Type	Watts	Primary	Secondary
809	15	500 ohms	15, 12, 8, 3.7, 2 ohms.
914	15	5000, 3000 P.P.	500, 250, 166, 125 and 106
915	15	5000, 3000 P.P.	15, 12.5, 8, 3.7 and 2
917	15	10,000, 8000 P.P.	500, 250, 166, 125 and 100
918	15	10,000, 8000 P.P.	15, 12.5, 8, 3.7 and 2
922	25	8000 P.P.	500, 250, 166, 125 and 100
891	35	6600P.P.	500, 250, 166, 125, 100, 83 ohms.
892	55	3200 P.P.	500, 250, 166, 125, 83, 62 and 50
928	5	7000, 5000 S.E.	12.5, 8, 3.7 and 2
929	10	4000, 2500 S.E.	15, 12.5, 8, 3.7 and 2
930	10	4000, 2500 S.E.	500, 250, 125
932	7	10,000 P.P.	15, 12.5, 8, 3.7 and 2

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ain constant and the effect of either
id of the filament swinging negative
ould be cancelled by the other end
vinging simultaneously positive.

Unfortunately, the problem does not
id with an effort to balance the fila-
ent circuit. During each cycle the
oltage applied to the filament rises to
peak value in one direction, falls to
ero, swings to a peak in the opposite
irection and then falls again to zero.

As a result, the filament temperature
aries in a cyclic fashion and with it,
ie supply of electrons. This tends to
roduce hum in the output quite inde-
endently of any interaction between
id bias and A.C. on the filament, as
lready explained.

ARLY AC VALVES

Despite these very serious problems,
ie first all A.C.-operated receivers did
se directly heated valves in most sockets.
The valves were not ordinary battery
pes, however, but had special low-volt-
ge high-current filaments which were
assive enough to maintain a fairly even
mperature, notwithstanding the A.C
pply.

The designers did not rely on a centre-
pped transformer winding, either, but
arthed the filament wiring through an
djustable "centre-tapping" resistor, which
as set in each receiver to give the
west possible order of hum

But, for all these precautions, early
.C. receivers were distinguished by their
ery high hum level.

A satisfactory solution to the pro
lem only came with the introduction
f valves having "indirectly heated"
athodes. Figure 2, reprinted from the
arlier chapter on valves, illustrates the
ifference between such valves and earlier
pes having directly heated filaments.

In the case of indirectly heated valves
lectrons are emitted from the surface
f a metal tube, which is coated with
uitable emissive oxide This is com-
nonly referred to as the "cathode."

Inside the tube, but insulated from it
lectrically, is a "heater" element, the
ole purpose of which is to raise the
mperature of the cathode tube or
leeve to a red heat, so that it will
mit electrons freely from its surface.
he heater element plays no other part
n the functioning of the valve

ITHER SUPPLY

This being the case, it can be fed
rom either an A.C. or a D.C. source
nd does not affect bias or signal vol-
ge, which is purely a matter of the
elative voltage between the grid and
he cathode sleeve. What is more, the
nass of the heater and cathode assem-
ly is such that its temperature does
ot vary to any noticeable extent over
he A.C. input cycle. The two major
ources of hum are therefore obviated

With the development and release of
alves having indirectly heated cathodes
he major problem with all-mains opera
ion disappeared and numerous receivers
ere released using them. It was still
ecessary to produce from the mains a
ure D.C. supply for the valve plates
nd screens, but, as we shall see, this
as not—and is not—a major problem

Figure 3 shows a typical power supply
ircuit, whose operation we can proceed
o discuss.

Heart of the supply is the power
ransformer, which is shown diagrama-
ically as a number of windings adjacent
o an iron core

The incoming power lead is connected across the PRIMARY winding, which will normally be rated to receive an input of 240 volts A.C. It must be A.C. A power transformer MUST NOT BE CONNECTED across D.C. mains. If it is, it is almost certain to blow the fuses or burn out itself or do both!

The reason for this is not hard to discover in that a transformer relies for its operation on a constantly changing magnetic field.

As the alternating current from the power mains flows to and fro through the primary winding, it causes a strong magnetic field in the iron core to build up and collapse in cyclic fashion.

The moving lines of force thus created induce current and voltage in the various SECONDARY windings, obeying the laws of magnetism explained in an earlier chapter.

The alternating voltage developed across each secondary winding is almost exactly proportional to the ratio of turns between the primary and the secondary winding in question.

Thus, if there are 1,200 turns on the primary winding, a secondary winding also having 1,200 turns would deliver the same 240 volts as fed into the primary—because the turns ratio would be 1:1

On the other hand, if a 6.3 volt winding is required to operate a number of valves with 6.3 volt heaters, then this heater winding would need to have 1,200 times 6.3/240, equals 32 approx. turns.

TURNS PER VOLT

In the above illustration we suggested 1,200 turns for a 240-volt winding on the assumption that the transformer might be wound on the basis of five turns for every volt of input or output. This is a likely enough figure, but, in practical transformers, the turns-per-volt figure may vary considerably from one type to another, according to the size of the core, the grade of the iron used and the ideas of the designer.

The thickness of the wire used on each winding depends on the current which it has to handle or deliver. In the case of a heater winding, which may be required to deliver several amperes, relatively thick wire has to be used and it is commonplace to see heater windings using 16-gauge enamelled wire or thicker.

It is important to realise that the gauge of wire used in a transformer winding determines only the amount of load current it can handle without overheating, IF REQUIRED TO DO SO. Thus a winding rated to deliver, say, three amperes, can deliver up to three amperes without tending to overheat, according to the number of valves which may be connected to it.

Typical radio type power transformers may have one or two, or even three, heater windings, to give the amount of voltage and current likely to be required in the particular sets for which they are intended.

A small transformer, intended for use in a four-valve mantel set, may only have a single heater winding rated to deliver 6.3 volts at two amperes. One intended for use in a very large receiver may have two or three windings to supply the larger number of valves involved.

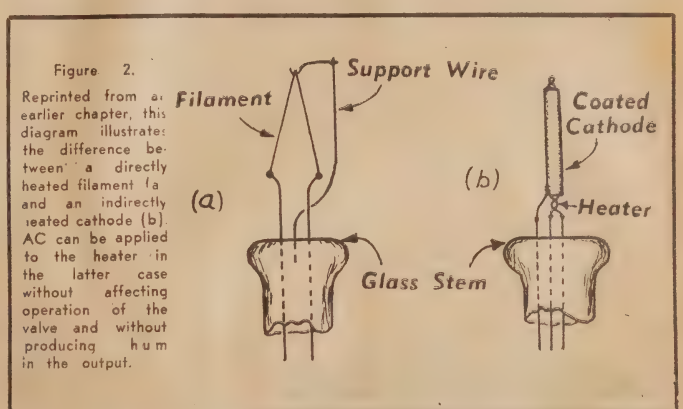

Figure 2.

Reprinted from an earlier chapter, this diagram illustrates the difference between a directly heated filament (a) and an indirectly heated cathode (b). AC can be applied to the heater in the latter case without affecting operation of the valve and without producing hum in the output.

In the circuit of Figure 3 we have shown two heater (or filament) windings, one to supply the rectifier and the other to supply the heaters of all other valves in the receiver. The latter is marked "6.3V" because, nowadays, most valves intended for mains operation have a 6.3-volt heater.

The winding is also shown as having a centre-tap connection, earthed to the chassis. This earth connection has nothing to do with the basic functioning of the associated valves since, as we pointed out earlier, the heater's only role is to raise the temperature of the cathode sleeve so that emission can take place.

Heater wiring is usually earthed for two reasons:

Firstly, the heater winding is very close, inside the transformer, to other windings producing high alternating voltages. Because there is some capacitance between them some of the high voltage energy can be coupled capacitively to the heater winding and to the wiring connected to it.

RIPPLE VOLTAGE

This doesn't interfere in any way with the basic operation of the heater circuit but the high ripple voltage present on the heater wiring throughout the chassis can couple into grid circuits and produce an objectionable hum or buzz in the output.

A second reason is that wiring running

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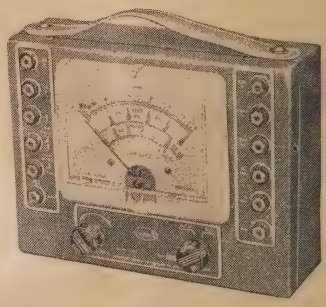

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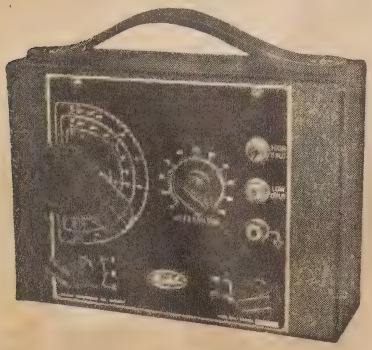

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rom one stage to another throughout high-gain receiver can transfer signals y stray coupling and produce trouble-ome regeneration.

Earthing the heater wiring largely bviates both effects.

Although we have shown a centre-tap arth return, this is not strictly necessary xcept, perhaps, in equipment having ery high audio gain. In most cases it is ufficient to earth one side only of the eater wiring.

As we pointed out earlier, there can e no question of applying an alternating otential to the plates, screens or grids f amplifying valves, since the alterna-ion would be construed as a low fre-uency signal and heard in the output s a hum, blanketing any other signal hich might be present.

For these electrodes, AC from the ains must be rectified and filtered till t becomes virtually pure DC. This nvolves, normally, a high tension econdary winding on the power trans-ormer, a rectifier valve, a filter choke nd two or more filter capacitors.

IGH VOLTAGE

As might be expected, the high ten-ion winding involves many turns of fair-y fine wire, so that a considerable volt-ge is developed between its outer ends. ince the voltage across it is alternating, ach end swings alternately positive and egative with respect to the other.

As a rule the high tension secondary inding has a centre-tap which is re-urned to chassis (shown as earth) so hat half the total secondary voltage ppears between earth and the respec-ive ends. When one end of the winding wings positive with respect to earth the ther end simultaneously swings nega-ive by an equal amount.

As with the heater windings, the ating of the high tension secondary, in erms of voltage and current, varies with he size of transformer and the receiver hich it is to supply. A small trans-ormer, to supply a small mantel re-eiver, might typically have a HT secon-lary rating of 150 volts either side of he centre tapping, at a nominal current ating of 30 milliamps—this figure refer-ing to the permissible DC load current.

A large transformer, intended to upply a large receiver or amplifier, night have a voltage rating per side of p to 400 and a nominal DC load cur-ent of up to 250 or even 275 milliamps.

The two ends of the HT secondary inding are connected to two plates in a ectifier valve, as depicted. This valve s virtually two diode elements in the ne envelope, the plate and filament tructure being expressly designed to arry a considerable amount of current.

A valve of this type, intended for use n a power supply and having two eparate anodes or plates, is commonly eferred to as a FULL WAVE RECTI-IER.

OSITIVE VOLTAGE

The filament of the rectifier is fed rom a separate winding on the trans-former, which is typically rated to de-iver five volts at two or three amperes. It is quite usual for rectifier valves to consume considerable heater or filament power, the cathode or filament being designed to provide copious electron emission and thus allow the valve to pass heavy current without danger of early failure in service.

To follow the action of the rectifier, consider the instant when a positive volt-age has appeared on the upper half of the H.T. secondary and therefore on the left-hand rectifier plate, as drawn.

Since the plate is positive, electrons will tend to flow to it from the heated filament. We can consider the result in a couple of ways, both of which lead to the same conclusion:

(1) In losing electrons, which are essentially negative charges, the filament of the rectifier must itself become positive.

(2) When conduction takes place through the rectifier, the impedance of the filament-to-plate path in the valve must decrease. The filament must, therefore, approach the plate potential, and, since this is temporarily positive, the filament must tend also to become positive.

Whichever way one cares to look at it, the result is the same—a positive potential on the plate and conduction through the valve produces a positive voltage at the filament.

When the same plate swings negative, during the next half-cycle, there is no conduction through the valve and therefore no tendency for the filament to develop a simultaneous negative potential.

On the contrary, as the first plate swings negative, the second plate simultaneously becomes positive and conduction takes place between filament and this second plate. Once again, therefore, the filament tends to be carried positive.

In other words, during successive half cycles, when each plate in turn swings positive, current flow through one half of the rectifier or the other tends to carry the filament positive also. Since there are 100 half cycles per second, with 50-cycle power mains, 100 positive pulses are apparent at the rectifier filament per second.

The 50-cycle alternating voltage at the rectifier plates is thus changed to pulsating D.C. at the rectifier filament, positive with respect to chassis and having a heavy ripple content of 100 cycles per second.

This positive voltage is generated at the rectifier filament quite independently of the five-volts A.C. coming from the transformer winding to heat the filament. This latter voltage, applied across the rectifier filament, raises it to operating temperature. When the positive voltage is generated, it carries the filament as well as the transformer winding feeding it, to a high positive potential in respect to chassis.

Obviously enough, since the rectifier filament winding is expected to be at a positive potential with respect to chassis, it must not be earthed.

Instead a wire connected to one wire of the filament or its supply winding becomes the source of the positive potential which must ultimately be fed to the plates and screens of the amplifying valves in the receiver.

However, the plates and screens must be fed with substantially pure D.C., not a voltage which has a very high ripple content. To get rid of the ripple, it is necessary to use what is known as a FILTER system, involving, usually, a filter choke and a number of filter capacitors. These are shown in figure 3, but an explanation of their operation must wait till another issue.

(To be Continued)

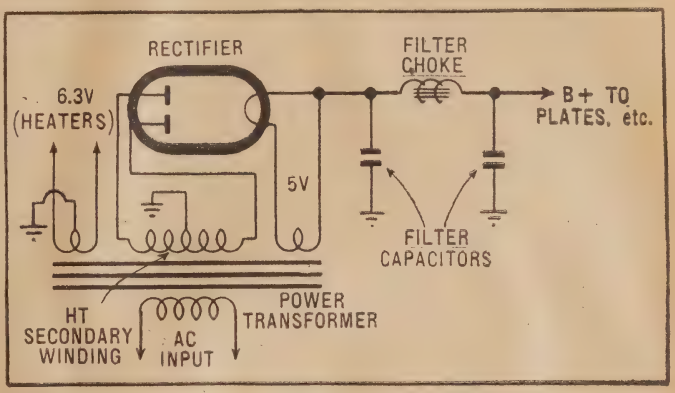

Figure 3: Here is a basic and typical power supply circuit of the type used in domestic receivers. It supplies filtered high voltage DC for the plates and screens of the amplifying valves and AC for their heaters.

THE TRF ECONOMY FIVE RECEIVER

(Continued from page 39)

back bias resistor on the other side of the chassis.

A five-terminal strip near the centre RF coil supports the two 33K HT line bleed resistors and the 68K screen dropping resistor.

Three trimmers are required, one and are used to adjust the set for maximum efficiency. We have been over the subject of alignment many times before, and a pamphlet is available through our query service for those who require some help in this regard.

And that is about all there is to tell about the set. You should have no trouble getting it working and it should have adequate sensitivity for most suburban locations. Further out it may still be useful, but will undoubtedly call for a more elaborate aerial than the usual odd length of wire.

A COURSE IN TELEVISION

Part 26—SYNCH. SEPARATION CIRCUITS

Following the discussion on video amplifier stages, the next logical step is to examine the means by which the synchronising pulses are separated from the total video signal and made available to the horizontal and vertical oscillators in the receiver.

DEFLECTION circuits and sawtooth oscillators in particular have not yet been examined in this series and the relationship between them and the synchronising circuits will only become fully apparent as the discussion proceeds.

In general, every receiver incorporates two basic sawtooth oscillators, one to operate at the frame (or field) frequency and the other at line frequency. In the Australian system, the two frequencies are respectively 50 and 15,625 cycles per second.

No practical oscillator is sufficiently stable of itself to remain synchronous with the picture scanning cycle at the transmitter for any lengthy period and those in the receiver are deliberately designed to "lock" with synchronising pulses radiated along with the video signal.

Therefore, irrespective of any other picture information the composite video carrier always provides a pulse which can trigger the horizontal oscillator at the end of each line scan. If not used to trigger the horizontal oscillator directly, the pulses are used to actuate a frequency control circuit, operating in turn on the oscillator.

VERTICAL SYNCH.

By the same token, a special grouping of the synch. pulses provides a signal to trigger the vertical oscillator at the end of each frame.

Normal practice is to design the oscillators so that their free-running frequency is just a little below the required figures. The synch. pulses trigger each new cycle just before its natural period and therefore raise the oscillators in each case to the required synchronous frequency.

The synch. separation circuits have two distinct functions: (1) to separate out the synch. pulses and discard the video information and (2) to interpret the pulses and derive from them the pulse information required by the two oscillators.

In the video carrier and in the video signal after detection in the receiver, the prime distinction between the synchronising pulses and the actual picture information is one of amplitude.

With a positively modulated carrier, white represents peak carrier amplitude and black about 30 per cent of peak. The synchronising pulses, occurring between lines and during the frame retrace period, reduce the instantaneous carrier amplitude to near zero.

POSITIVE MODULATION

Thus the synch. and picture information occupy respectively about 0-30 and 30-100 per cent of modulation level.

With negative modulation, as used in Australia, the reverse procedure is adopted. Peak white is equivalent to a carrier amplitude about 10 per cent of maximum and black to about 75 per cent of maximum. For synch. pulses the carrier rises to full rated amplitude or power — equivalent to 100 per cent.

In this case, therefore, the synch. and picture information occupy respectively 75-100 and 10-75 per cent of modulation level.

After detection, the high frequency carrier or IF component is removed and only the composite video signal remains, comprising the basic picture information and the superimposed synchronising pulses.

The polarity of the detector determines the sense of the demodulated picture and synch. signals with respect to earth. It is possible to have either synch. positive or synch. negative signals across the detector load, from either a positive or negatively modulated carrier, according to which way round in circuit the detector is connected.

After detection, in fact, there are only minor differences in the composite video signal obtained with either method of modulation. A peak signal excursion in one direction signifies white; an excursion in the opposite direction indicates a change through grey to black; synch pulses extend beyond the black level into the so-called "infra-black" region.

Of the total excursion, in each case picture information from white to black occupies just over two-thirds and synch information just under one-third.

These observations pre-suppose that the amplitude excursions of the original carrier are faithfully preserved in the receiver and this assumption is not always a safe one to make.

As we have already seen, there are notable difficulties about providing a satisfactory automatic gain control circuit in a television receiver, and varying degrees of overload can readily occur particularly in the final video IF amplifier stage.

Assuming that this stage operates with fixed bias, it may reproduce well enough signals representing lower orders of modulation but may compress large carrier excursions, due to the onset of grid current and its effect on the preceding stage.

PICTURE TEARING

With a negatively modulated carrier the compression becomes evident first on the synch. pulses and is responsible for a large proportion of the picture tearing troubles which occur in very strong signal areas.

If overload conditions are created artificially in a receiver, by interfering with the AGC action, pulse compression and loss can be observed fairly easily on a wide-range oscilloscope. Instead of the synch. pulses extending well beyond the general picture level, they may easily be reduced to a few per cent only of the total amplitude variation.

When this occurs, the synch. separation stage cannot function properly because there is so little difference in amplitude between picture information signals and the synchronising pulses.

The separation stage may still produce synchronising information of a kind, responding to the wavefront at the end of each line, where the video level suddenly reverts to blanking level, prior to sending the synch. pulse.

Synchronisation under these conditions must be very uncertain, however. If the right-hand portion of the picture should happen to be dark, the rise to blanking level is largely missing. Or again, if a sharp white-to-black edge should appear near the right hand edge,

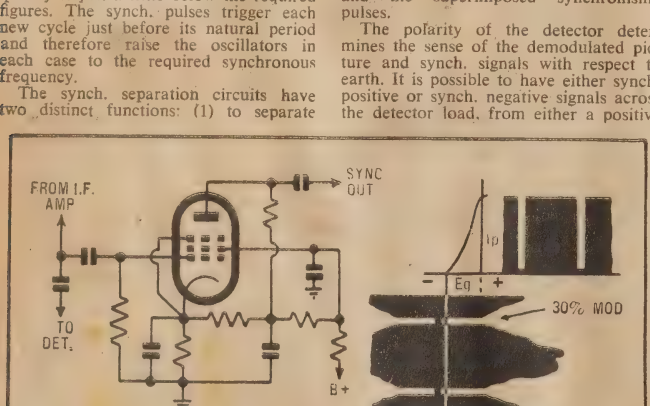

Figure 143: A synch. separation stage designed to operate from the last IF amplifier on positively modulated signals. It has no immediate local application but is mentioned for the sake of interest.

may cause the separation stage to pro-
ıce a pulse too eagerly, resulting in
isplacement or tearing of portion of
ıe picture.

The horizontal oscillator is affected
so because signal compression robs it
so of its essential synch. information.
ı some cases, poor vertical locking is
ıe first indication of loss of synch.
ılses, occurirng even before horizontal
cture tearing.

The importance of these remarks can-
ot be overstressed, particularly for any-
ıe concerned with servicing television
ceivers in the field. In cases of poor
cture locking, ostensibly due to inade-
ıate synch. pulses, there is an even
ıance that the trouble may be in the
ront-end" and AGC circuitry and in-
ılving signal compression.

VERLOAD CONDITION

While it is important to preserve the
tal signal prior to synch. separation,
e actual separator stage itself norm-
ly operates in an overload condition.
/ feeding a large amplitude signal to
and ensuring that it can handle only
ıall amplitude, the desired portion of
e total signal is preserved, the rest
ing suppressed.

Operation of the synch. separator is
turally made simpler and less criti-
l, if fed with a high amplitude signal.

In some early English receivers, par-
ularly those involving a high level de-
ctor feeding directly to the picture
be, separation was effected directly
om the IF signal.

While this has no immediate appli-
tion to local conditions, it is sufficient
erest to warrant passing mention.
igure 143, reprinted from our earlier
urse, shows just such a synch. separ-
on stage, fed with a positively modu-
ed signal from the last IF amplifier.

Figures published at the time for the
cuit suggested a network of resistors
oportioned to give a standing screen
ltage of 50, a plate voltage of 10 and
fficient cathode bias to hold the tube
tially at the cut-off point, or slightly
yond.

When fed with input signal, the plate
rrent rises with each positive excur-
on of the grid but rapidly reaches a
aturation" figure beyond which it can-
t go. Signal excursion beyond this
int is therefore flattened off.

O PICTURE SIGNALS

If the peak input signal is high
ough, the plate current saturates be-
re blanking level is reached and all
the picture information is flattened
. The plate current therefore follows
e general pattern indicated at the
ht, containing only synch. informa-
n.

The circuit of figure 143 would clear-
not be applicable to a negatively mod-
ted carrier, since it would preserve
ne of the video signal and eliminate
e synch. pulses — just the reverse
what is required. It would obvi-
sly be necessary to modify its operat-
g conditions so that it would conduct
ly near the amplitude peak, corres-
nding to the pulse level.

In point of fact, current practice is
feed the synch. separator stage from
e video signal after detection and,
ually, after video amplification. This
sures a high amplitude of signal and

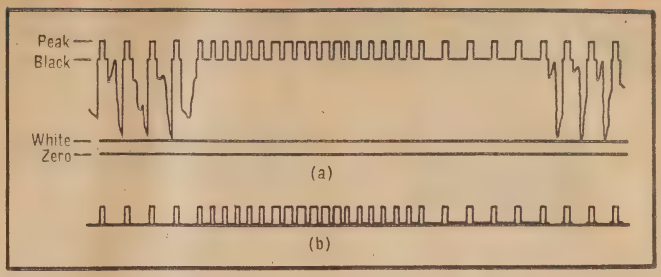

Figure 144: Diagram (a) indicates the general character of a composite video signal after detection. Diagram (b) indicates the train of pulses which should remain after correct separation has taken place.

avoids the necessity for critical adjust-
ment of circuit constants.

Figure 144 shows the action that is
required of a separator stage. Diagram
(a) shows the total video signal and (b)
the train of pulses which remains after
the video information has been suppres-
sed.

When fed with a video signal after
detection, the polarity of the input sig-
nal and the operation of the separator
stage must be complementary. If the
stage is arranged to separate out the
positive amplitude excursions, then it
must obviously be fed with a synch.
positive signal.

Nor does the requirement end there.
In traversing the separator stage, the
pulses may undergo an inversion or a
double inversion of phase, emerging as
either positive-going or negative-going
pulses. This can be important to the
deflection oscillators, some locking more
reliably to positive, some to negative
pulses.

**In other words, a circuit designer
must have the same care in manipu-
lating the sense or phase of the syn-
chronising pulses, as with the sense of
phase of the signals feeding the pic-
ture tube intensity circuit.**

Figure 145 illustrates a number of
elementary circuits capable of separat-
ing synchronising pulses on an ampli-
tude basis. All require a synch. positive
input, of the type inferred by figure
144.

Diagram (a) has the appearance of
a grid detector and that essentially is
what it is, except that the input signal
has already been rectified.

GRID NEGATIVE

On the succession of positive peaks
the grid draws current through R and
sets up a charge across C, making the
grid initially negative with respect to
earth.

The time constant of R and C is such
that the grid "base" potential remains
more or less constant and sufficiently
negative to hold the valve to cut-off
over the picture signal interval.

The grid swings positive and plate
current flows only during the brief high

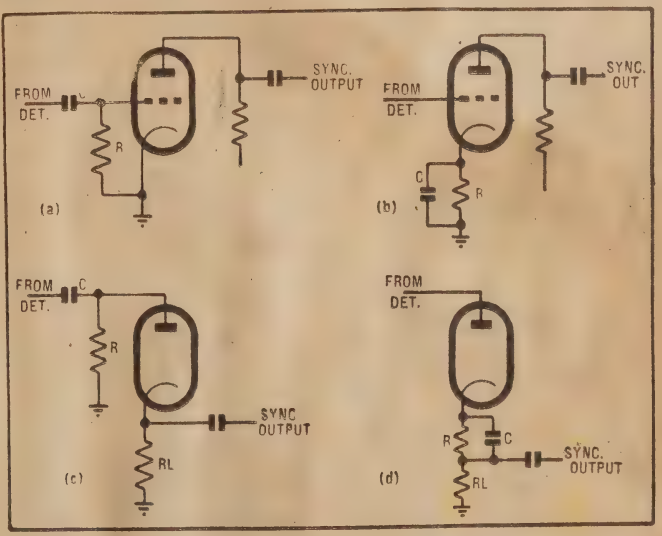

Figure 145: Four elementary circuits, capable of separating synch. pulses from a synch. positive video signal. Most modern separator circuits involve one of the above functions but with supplementary amplification and limiting to give pulses of a larger and completely constant amplitude.

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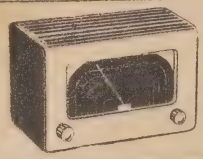

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★ SPECIALS ★

12. **Few only IFF sets type BC966.** Brand new with 3-7193 7-6SH7 and 3-6H6 valves, an 18 volt to 450 volt at 50 ma generator and blower, carbon pile regulator, 3 multi contact relays and dozens of resistors and condensers of all types. **Price only £5/10/.**
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19. We have just received stocks of the following Condensers, all are brand new and perfect and made by well-known makers.

Capacity	Wkg. Voltage	Type	Price
.003 mfd	3000	Mica	2/6
.005 mfd	400	Mica	1/-
.001 mfd	5000	Mica	2/6
.01 mfd	1000	Mica	1/6
.01 mfd	2000	Mica	2/6
.01 plus .005 plus .001 mfd	600	Block	1/6
.015 mfd	2000	Mica	2/6
.01 plus .01 mfd	600	Block	1/6
.02 mfd	1000	Mica	2/-
.025 mfd	2000	Mica	2/9
.05 plus .05 mfd	400	Block	1/9
.1 mfd	1500	Block	2/-
.1 mfd	4000	Block	5/6
.25 mfd	2000	Block	2/9
2 mfd	400	Block	3/3
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4 mfd	750	Block	6/6
5 mfd	400	Block	4/-
3 plus 5 mfd	110AC 400DC	Block	7/9

20. **Resistors.** These resistors have been made for the British Navy or other branches of the services and are of extremely high quality. Brand new.

Resistance	Tapping	Power in Watts	Price
36		100	5/-
45		100	5/-
50		20	2/-
100		40	3/-
125		10	1/6
150		20	2/-
300		20	2/-
350	Variable Tap	25	2/6
500		25	2/6
500		100	5/-
700		20	2/-
850		20	2/-
2,000		150	5/-
3,000		120	5/-
5,000		20	2/-
5,000		40	3/-
5,500		12	1/6
10,000	Tapped 3,000	55	4/-
15,000		20	2/-
15,000	Voltage Dividers		3/6
25,000		30W	2/6

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plitude synchronising pulses. Thus, plate current is substantially cut off ring the time when picture intelli nce is being transmitted, rising steep to form a pulse when the grid is rried positive by the high amplitude lse on the carrier.

Obviously, the time constant of R d C is important to successful opera n of the circuit.

Diagram (b) shows a rather similar t alternative arrangement. Here the h initial bias is obtained in the cath e circuit and produced by the pulses plate current.

OSITIVE PULSES

When the signal is first applied to the lve, the plate current builds up a tage in the cathode circuit which is eraged out" and held constant by the ger time constant of R and C. There er, plate current flows only during the h amplitude synchronising pulses. ich are sufficient to overcome the nding cathode bias.

Once again, great care is necessary selecting the values for R and C and o a high Gm. tube which generates h plate current pulses for moderate ut signals; while a triode is depicted both cases, pentode valves could be d, if desired.

The diode versions of these two cir ts are shown in diagrams (c) and

n diagram (c) the components R and are given a time constant long enough hold the diode plate substantially neg e and therefore prevent plate current v except on the positive peaks of nal.

On these positive peaks, however, a tage appears across the cathode load istor RL, while the corresponding cur t through "R" helps to maintain charge across "C" at a figure ap ximating the black or blanking level. n diagram (d) both loads are in the node circuit. Here R and C com e to hold the cathode initially posi e, the synchronising pulses appear across RL.

At first glance, it might appear that rating conditions in all these es must be maintained so that con tion will start when the signal just ses blanking level and continue over full height of the pulse. Fortunately h is not the case, because it would a very difficult state of affairs to ntain.

RGE INPUT SIGNAL

The idea is to feed the separator stage n a signal of considerable though not essive amplitude. By the action just cribed, this generates a proportion ty large standing bias.

Under these conditions the valve may in to conduct at a voltage point well ve blanking level and therefore safe clear of any picture information. In r words, a separator may be acti d only by the top portion of the ses.

hough the elementary circuits given igure 145 can separate synch. pulses m the total video signal, practical uits are usually a good deal more plex in their function. Modern ctice is to separate the pulses as in ted but, at the same time, pass them ough an associated stage—or stages —which both amplify and limit them.

The net result is that the pulses emerging from the composite stage have high but constant amplitude, which is virtually unaffected by variation in the strength of signals, by fine tuning or by adjustment of the contrast control.

This is a highly desirable condition because it largely eliminates any interaction betwen these functions and picture locking and stability.

Figure 146 shows the essential details

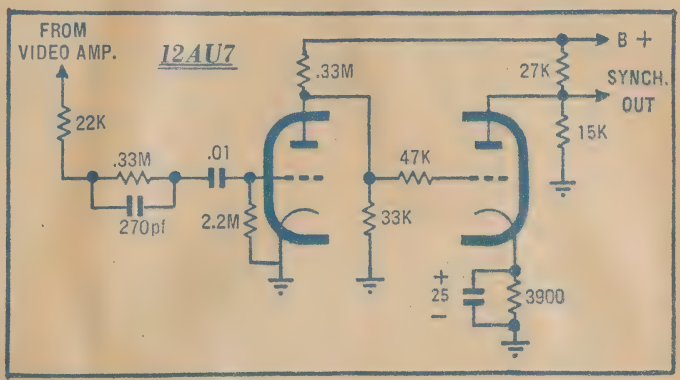

Figure 146: A typical two-stage separator-amplifier-clipper circuit, using a twin triode valves. Operation of the circuit is explained in the text.

of a separator-clipper-amplifier of the type used in the currnet R, TV and H. receivers, and using a 12AU7 twin triode.

It is intended to be fed from the cir cuit coupling the plate of the final video amplifier to the picture tube cathode, at which point the total video signal is synch. positive and having an amplitude of 30 to 80 volts peak-to-peak.

The 22K resistor, which normally at taches directly to the picture circuit wir ing, serves primarily to minimise capa citive shunting of the picture circuit.

The .01 mfd. is a blocking and coupl ing capacitor, which is also part of the grid time constant circuit in association with the 2.2M grid resistor. The .33M resistor and 270pF capacitor are intended to favour the high frequency com ponents of the synch. pulses and atten uate low frequency picture or noise signals, which make no contribution to synchronisation.

With input signal, grid current flows and generates a charge across the coupling capacitor and a bias across the 2.2M return resistor. The effect is such that the positive tips of the synch. pulses are virtually "clamped" at earth potential, the video signal excursion being almost entirely negative with respect to earth.

Because of the divider circuit in the plate of the first triode section, the operating plate voltage is very low — about 25—and the effective plate load is about 30K. Under these conditions, plate current is cut off with a grid bias of minus 2.0 volts or greater so that the video input signal must contain synch. pulses having an amplitude margin over this figure.

Basic separation can therefore be expected with video signals having a peak-to-peak amplitude of as little as 8 volts though, under practical viewing condition, a voltage considerably greater tions, this will be available.

With larger input signals, the peak of the pulses still remains clamped at about earth potential, the separator responding to only the topmost 2 volts of the synch. pulses, the rest of the pulses being suppressed, along with the picture information.

The basic operation of the first stage is supplemented, by the second stage, which is directly coupled to it and operates with a standing cathode bias of about 15 volts. When the voltage at the first plate rises, as its grid approaches cut-off, the second grid becomes positive and draws current, having a supplementary clipping action on the signal as a result.

Thus, any residual video information which remains after the basic separation functions, together with any which is fed through the circuit capacitively, is substantially attenuated.

The signal at the second grid is further amplified by this second triode section, which also operates with limited plate voltage, applied through a divider network. Irrespective of the magnitude of signal at the grid, this second triode cannot deliver a peak output beyond the limits set by the divider in one direction and by plate current and grid current saturation in the other.

CONSTANT OUTPUT

As a result of this multiple clipping action, the peak-to-peak output from the final plate remains at about 45 volts for any likely value of video signal to the input grid.

Because the synch. signal traverses two stages, it undergoes a double change of phase. Thus the synch. positive signal at the separator input becomes negative-going after the first stage and positive-going again, after the second stage.

These positive-going pulses are eminently suitable for the blocking oscillators used in the original receivers for both line and frame circuits.

(To be continued)

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- Measurement of capacitance.
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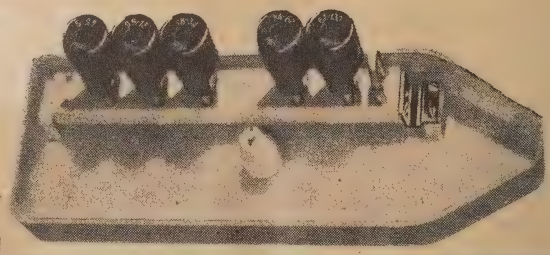

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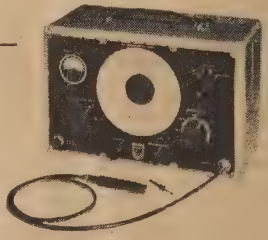

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WHAT AUDIO EQUIPMENT DO I USE?

MY reluctance is due largely to the fact that, if I mention piece of equipment by name, here are those who will assume n implication that I think it ie best in the field.

Nothing is farther from the uth.

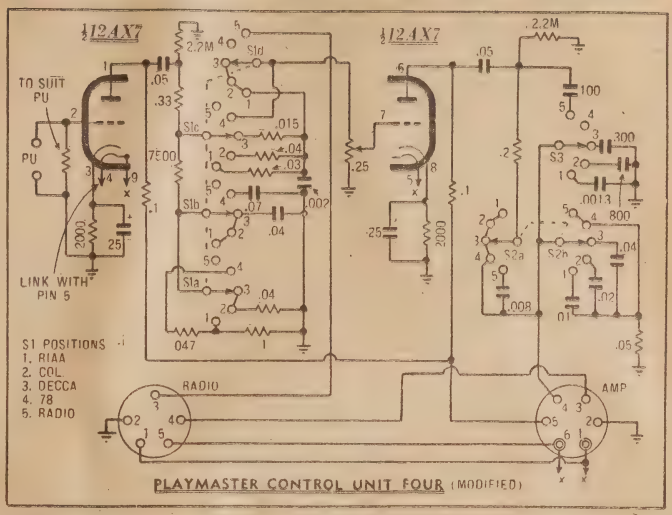
For instance, there are a number of ry good pick-ups on the market, de-ned to cater for all tastes and pockets. If I can only use one of them at a ne. It's reasonable to assume that I e the one I use, but it does not mean it there are no others with which I uld be equally pleased.

Similarly, although I have used most kes of speakers at one time or another, nust, perforce, settle on one of them mount permanently in my room.

It might help to make the point if I that I have at least six good quality kups and many more outdated types, veral of which I use from time to ne. I have probably the same number loudspeakers, ranging from the top ucket to more modest models, and of lse perhaps four will be pressed into vice over a given period.

In addition, I have had on loan just out every well-known type on the rket today, but it is quite obvious t I can't use them all.

have four high-grade motors, and am ually satisfied with them all. There little point in having them mounted



The Control Unit I use is the No 4 which is ted from the pick-up transformer. It is the same as the original except for two resistors added to reduce switching transients, and the removal of the high tension decoupling circuit which is now in the amplifier. The 100 mfd capacitor is rather large to fit inside the unit. The input grid resistor is 150K wired across the output leads of the pick-up transformer. Note the additional lead between the 5-pin and 6-pin sockets to carry through the separate high tension lead for the tuner.

One of the questions I am asked most often by readers and friends concerns the type of equipment I use to play records. And yet, although it is one of the most pertinent questions which an audio enthusiast can ask of another, it is the one I am least willing to answer.

in a row, with three of them idle for ist of the time.

Let me say again, therefore, that I use ipment because I think it is good, and ne of it I may think the best in the ld. But that is only my opinion, and s not mean that there are not other ivalents which will work just as well.

SY WAY OUT!

If I am pushed into a corner by an husiastic friend, I generally name a of parts so expensive that he shies y in horror, and he generally ends up a sensible man and picks the equip-nt which HE likes best.

After all, he is the man who has to pay it and live with it.

Another reason why I am writing this cle is that just about every record nufacturer sends me discs for review, , presumably, expects me to make ie intelligent comment about them. I n't think I can do this unless I hear m played on an outfit which is at t in the top bracket of quality.

One reason I have made numerous disc tape recordings myself is that, by so ng, I can better understand the prob-ls of the recording engineer and manu-turer.

And I think it might be a good thing for my readers to know what kind of sound I use in judgment, for, and I regret to say it, not all record reviewers own playback equipment of high quality.

However, by this time, maybe, I have made my point, and it might be as well to get on with it

The pick-up I use is an Ortofon type C with a 15-inch arm. This is a moving coil pick-up and very costly, but its results are very good indeed.

Because its performance is important in indicating the reproduction I can expect I might mention that I have tested it, as I do all high-grade pick-ups, for frequency response, output, IM distortion and square wave response, adjusting the load on its transformer secondary for best results.

by John Moyle

It is almost completely flat from 20 to 16,500 cycles, and at 22,500 cycles, the highest frequency I have on my test records, it rises by 4db. I would judge its resonance peak at about 26,000 cycles, but have not carried tests beyond that point.

Reproducing a square wave at 1 kc it shows some ringing, but this does not extend more than about one-third along the flat-top, if we can call it flat. Remember that the limitations of the cutting head are superimposed on such a pattern.

MOVING COIL PICKUP

I lean to moving coil pick-ups, because these are the only types I have tested so far which can give this kind of over all performance. Throughout its response there is no visible wave-form malformation.

Believe me, pick-up tests more elaborate than this are very hard to make.

I use a coupling transformer to step up the low impedance, low output voltage so that I can start out with a reasonably high level. This avoids the use of a very high sensitivity pre-amplifier,

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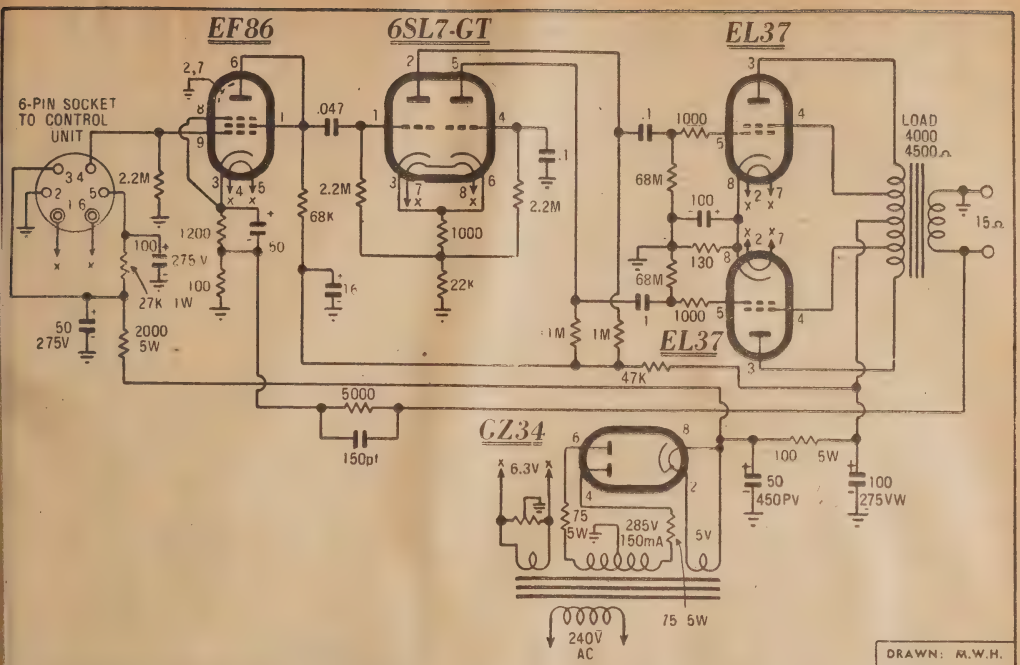

The amplifier is the original 17-watt Playmaster with some modifications to the high tension filtering circuit to increase stability, and the substitution of a high-gain phase-splitter. There is no filter choke used in this circuit. Note the separate high tension lead for the tuner.

hich I find, even in the best of cases, troduces some valve hiss.

Careful orientation of the transformer the only problem. I find it desirable park the amplifier with its power nsformer several feet away to minise hum pick-up and to shield carefully input and output leads.

The stylus pressure is only a couple of ams or so, and of course I use a diaond. Every so often I check the pick to make sure it has not deteriorated, even the best types can change with e and wear.

HE CONTROL UNIT

The pre-amplifier is the Playmaster ntrol Unit No. 4. It is the simplest, I have ample voltage available for I sometimes use the No. 6, but there little difference between them when feedback on the latter is correctly usted. The No. 6 is generally reserved tests with pick-ups having a lower tput, such as the variable reluctance es, which often find their way to the ntable.

like the switch type bass and treble ntrols because I like to know by how ch I am deviating from the pre-set yback curve. I find the 4 db steps about right, but, in fact, rarely use m.

A very occasional top cut, or bass ost, makes some discs sound better, as all makers use the RIAA curve adays I find the need for modificato this curve is not great.

find little use for slope controls, ble filters and the like, mainly bese my motors don't rumble and I ely play old records. When I do, I take them played back with the facilities available on either of these control units. If I listened more to older discs and less to new releases the story might be different.

I have wired 2 meg resistors to ground from the top ends of the .33 and .22 meg resistors where they connect to the .05 mfd. plate coupling capacitors in order to reduce switch clicks when operating the controls, but as I don't normally change these when playing this is a point which doesn't bother me.

Some readers have had microphonic troubles with the 12AX7—maybe I'm lucky, but I have not. Even a hearty smack on the control unit makes no difference. Careful selection of your valve seems to be the only answer here. Mine has been going strong for at least two years.

The amplifier I use most of all is a version of the 17-watt Playmaster, although it alternates with the 20-watt job when I feel like more power. Frankly, the bigger amplifier always sounds fractionally better to me, although on test the 17-watt job shows up best.

GOOD TRANSFORMERS

There seems to be something about the general balance of iron and copper in the 4,500 ohms output transformers made for this job which allows better response on both sine and square waves, and more freedom from instability, than with any other types I have tried to date.

All the well-known transformers made for this amplifier give excellent results, and I change them about a good deal in a kind of continuous experiment.

Used with the correct phasing capacitor in the feedback circuit, they all give excellent square wave response at 5 kc, my favourite test frequency. One shows only microscopic ringing as high as 10 kc—you almost have to hunt for it. This same job is only 1 db down at 125 Kc, and falls smoothly to 4 db down at 250 Kc and 7 db down at 500 Kc. At 20 cycles it is down .2 db.

Best of all, these transformers all hold substantially flat output between 30 cycles and at least 20 Kc, the best producing nice sine-waves at nearly 17 watts up to 50 Kc. Another produces almost full power at less than 20 cycles.

LOW DISTORTION

Tests show a .15 per cent maximum total harmonic distortion up to 10 watts over the audible range. Mostly the measuring devices provided more distortion than this at certain spots, and only the best laboratory equipment is reliable for standards as good as this.

The distortion figure quoted relates to the lower end of the frequency range. Over the greater part of the response curve it is less than .1 per cent.

I cannot make the complete equipment unstable even at full bass boost and full gain setting with any kind of input, nor is there any sign of high frequency oscillation at any output or frequency, including overload conditions.

I don't imagine better overall results than these are likely to be turned in by anybody. At least I have never observed them.

I would like to pause in this recital to say something about this matter of motorboating.

It is a very difficult task to build a high output amplifier system of high sensitivity, using the same power supply

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for everything, which will not exhibit a slight tendency to motorboat under abnormal conditions of sensitivity and bass boost.

The prime cause is mutual coupling through the power supply circuits, aided and abetted by transformer design and other circuit constants.

The tendency is aggravated by very high degrees of negative feedback, which will also seek out any abnormal output transformer resonances in the supersonic regions. These often cause oscillation without drastic and often multiple cures which affect performance.

For this reason I have always advocated a maximum feedback of 20 db, with the proviso than more than this can be applied without overstepping the safety margin.

LF STABILITY

However, with the inevitable modifications to performance due to a wide variety of components finding their way into home-built amplifiers, and perhaps thoughtless wiring habits, it seems that some readers have experienced motorboating troubles.

For this reason, when making some experiments recently with this amplifier, I gave some thought to the problem.

The appearance on the market of high capacitance electrolytics and their easy use in a circuit using a 300 volt supply, enabled me to greatly improve the margin of safety.

The control unit and radio tuners are now fed through a connection made directly to the high tension rectifier, thus avoiding a common impedance coupling through the smoothing choke. This, of course, is an old dodge, made more effective by a couple of 24 mfd. capacitors wired across the rectifier output.

With the GZ34 rectifier, the makers allow such a value, provided small resistors are used in series with the rectifier plate connections to limit the peak current flow.

There is a formula for working out the exact value, but I have found that 75 ohms is about right for a power transformer of the type used.

A 2,000 ohm resistor comes next, to provide a feed point for the tuner, and this point is bypassed with a 50 mfd capacitor. This reduces the ripple to a negligible amount, and gives me 230 volts.

CONTROL UNIT FILTER

The next filter section feeds the control unit, and consists of a 27K resistor and the largest capacitor I could find, a 100 mfd electrolytic rated at 275 volts working.

This section takes the place of the decoupling network originally fitted to the control unit, made up of a 25K resistor and a 16 mfd capacitor. These two components are therefore removed from the unit.

The voltage available at the end of the 12AX7 plate load resistors is now 300 volts, substantially higher than in the original circuit, and this reduces the already low distortion produced by the valve.

The overall stability of the system is now as good as that obtained by using separate power supply using standard component values.

If a tuner is not used, the 2,000 ohm resistor may be increased in value to reduce the control unit voltage, but this is hardly worth the trouble. It should not be omitted, however, as it plays a significant part in the filtering. Increasing its value to reduce the voltage to 200 would increase the effectiveness of the filter and the stability of the unit.

There is no objection to using 300 volts applied to the control unit, as long as all capacitors are rated to accommodate the extra voltage.

The capacitors used at the rectifier must have a working voltage rating of at least 350, and a peak voltage rating of at least 450. The others may all be of the 275 volt working type.

There are so many capacitor types available now that I could not list all those suitable but these limits should guide you.

Do not use more than a total of 50 mfds. at the rectifier, but the sky is the limit for the other two.

The amplifier itself, largely because of the high filter capacitance, now operates without a filter choke at all. In its place there is a 100 ohm 5 watt resistor which drops the voltage for the amplifier proper to about 270 volts. Subtracting the cathode bias, the valve plates thus receive about 250 volts, enough for them to produce their 17 watts at 1 Kc.

At this rating, the EL37s are merely idling, for, without circuit alterations, the high tension could be raised to 325 volts, with a rise in output to about 35 watts.

I like these valves because of their high output at modest voltage, ample reserve, and because filter capacitors present no problem. Apparently many other designers think the same because, despite the appearance of new types, the EL37 refuses to die.

The hum level without the choke is very slightly greater, but you will have to get down on your hands and knees in a quiet room to hear the difference. I am very fussy about residual hum, but even I can't justify the choke on this ground alone. Walking about the room, even close to the speaker cabinet, it is difficult to say whether the amplifier is turned on or not. Several times I have left it on all night because I didn't realise I had not switched it off.

There isn't much justification for using the 6SL7 as a phase-changer in place of the 6SN7. It gives more gain, which increases the feedback to about 23 db and total sensitivity for full output to about 260 milivolts. I wired it in mainly for an experiment, and left it there. With the 6SN7, feedback was almost exactly 20 db, and sensitivity about 280 millivolts. Performance otherwise does not appear to be altered.

Why is the EF86 used as a triode? Because it gives too much gain as a pentode, and would require much more feedback with greater danger of instability. A figure of 23 db is ample to reduce the output impedance to a very low figure, and a lower distortion at listening levels would be undetectable. Test figures might look a little better on paper, but that is all.

PHASE-SPLITTER BALANCE

All carbon resistors are 1-watt types, mainly because they have a margin of safety and stability which is good to have. Note that there is a small unbalance in the plate resistors for the 6SL7 to obtain good balance. I estimated their values from general experience with this well-used circuit, and perhaps they could be adjusted more accurately by special test. I have never bothered to do this.

I use a potentiometer to adjust the centre-tap of the filament winding, setting it on a CRO for lowest hum level. If you can hear any difference at all, you could set it by ear, but it's a mighty fine point in many cases.

The loudspeakers I use most of all are made by Wharfedale and consist of the standard 3-speaker set-up.

There is a 15-inch woofer mounted in a completely enclosed box of about 8 cubic feet capacity. This is perhaps the weakest link in the chain at the moment, and I have long planned to make a larger and more robust enclosure, possibly using the famous sand-filled panels. I am not quoting my speaker mounting as ideal or even good, but it does produce very smooth, clean bass down to 25 cycles, although I have to walk into the next room to get the full effect of such frequencies.

The box was originally a vented enclosure, but, following on some experiments I made last year, I blocked up the vent. The speaker has a cone resonance, or did originally, of about 22 cycles, which, from memory, goes up to about 40 cycles in the box. I have some fine test discs, including some organ recordings by Cook, and I'd have to move into a more robust dwelling to appreciate more bass power than I can get.

Incidentally, I have noticed that the really low stuff sounds rather cleaner since I modified the original circuit, and possibly this can be attributed to the better stability at the very low end, particularly if I use high volume and some boost. After all, it's very logical that it should be so.

The middle speaker is an 8CS/AL and the tweeter the Super-3. They are fed

(Continued on Page 111)

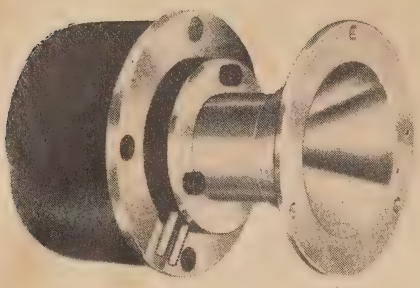
AMPLIFIER PERFORMANCE DATA

Here is some information on the performance of the main amplifier. A standard multi-meter was used.

Voltage at rectifier—280 volts.
Voltage at output transformer—268 volts.
Voltage available for tuner—230 volts.
Voltage available for Control Unit—200 volts.
Maximum current drain—153 mills.
Current drain of output stage—125 mills.
Tuner current drain with signal—24 mills.
Control unit current drain—1 mill.
Output stage bias—16 volts.

The capacitor in parallel with the feedback resistor should be selected to suit the output transformer. For both A & R and Ferguson transformers, 150 pf is used. The Bramco transformer may be operated with the same value, but its optimum capacitor is 68 pf. The output transformer core should be mounted exactly at right angles to that of the power transformer, and ideally its precise positioning should be determined by experiment to produce the least hum coupling.

Goodmans 3 WAY FULL RANGE LOUDSPEAKER System



TREBAX HIGH FREQUENCY PRESSURE UNIT

Trebax is a new high efficiency pressure driven reproducer covering the treble register in multi-channel High Fidelity systems. The frequency coverage is achieved with complete freedom from irregularities in response. The efficiency of TREBAX is such that it may be used with the most efficient bass and mid-range units.

SPECIFICATION

Frequency Range	*2,500 c.p.s. to 16,000 c.p.s.*
Impedance	*15 ohms at 10 Kc/s.*
System Power Handling Capacity	*25 watts.*
Crossover Frequency	*5 Kc/s.*

MIDAX MID-RANGE PRESSURE DRIVEN HORN UNIT

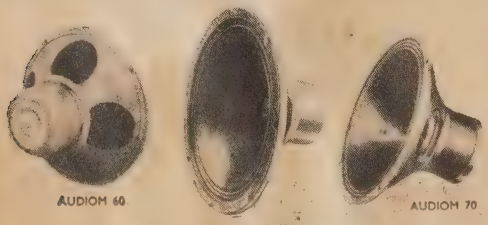
This entirely new reproducer is designed for high efficiency low distortion coverage of the middle register in multi-channel high fidelity systems.

It consists of a pressure driver and horn unit designed to cover a total frequency range of 400 c.p.s. to 8 Kc/s.

The efficiency of Midax is such that it can be employed with any direct radiator up to 18 inches in diameter.

SPECIFICATION

Frequency Range	*400 c.p.s. to 8 Kc/s.*
Impedance	*15 ohms at 400 c.p.s.*
System Power Handling Capacity	*25 watts.*
Crossover Frequency	*750 c.p.s. and 5,000 c.p.s.*



AUDIOM 60 AUDIOM 80 AUDIOM 70

AUDIOM BASS LOUDSPEAKER

The AUDIOM series of loudspeakers are robust single cone units and feature the refinements necessary for very low distortion reproduction of the bass register and the high reliability under full load conditions. The cross-over points may be placed at any frequency below 800 c.p.s. depending on the requirements of the other units.

SPECIFICATION

	AUDIOM 60	*AUDIOM 70*	*AUDIOM 80*
Flux Density	*14,000 GAUSS*	*17,500 GAUSS*	*17,500 GAUSS*
Bass Resonance	*35 c.p.s.*	*35 c.p.s.*	*35 c.p.s.*
Power Handling Capacity	*15 watts*	*20 watts.*	*25 watts*
Impedance at 400 c.p.s.	*15 ohms.*	*15 ohms.*	*15 ohms.*

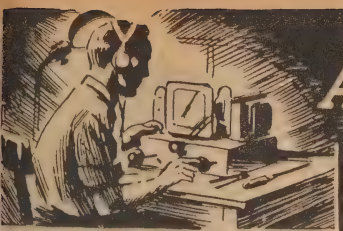
Demonstrations and Supplies Available from

- NEW SOUTH WALES: United Radio Distributors Pty. Ltd. Audio Engineers Pty. Ltd.
- VICTORIA: Homecrafts Pty. Ltd., J. H. Magrath & Co. Pty. Ltd., Radio Parts Pty. Ltd. Warburton, Franki (Melbourne) Ltd.
- SOUTH AUSTRALIA Gerard & Goodman Ltd. Newton McLaren Ltd. Radio Electric Wholesalers Ltd.
- QUEENSLAND: Chandlers Pty. Ltd.
- WESTERN AUSTRALIA: Atkins (W.A.) Limited Carlyle & Co. Limited.

Sole Australian Agent:

BRITISH MERCHANDISING PTY. LTD.

BOX 3456 G.P.O. SYDNEY

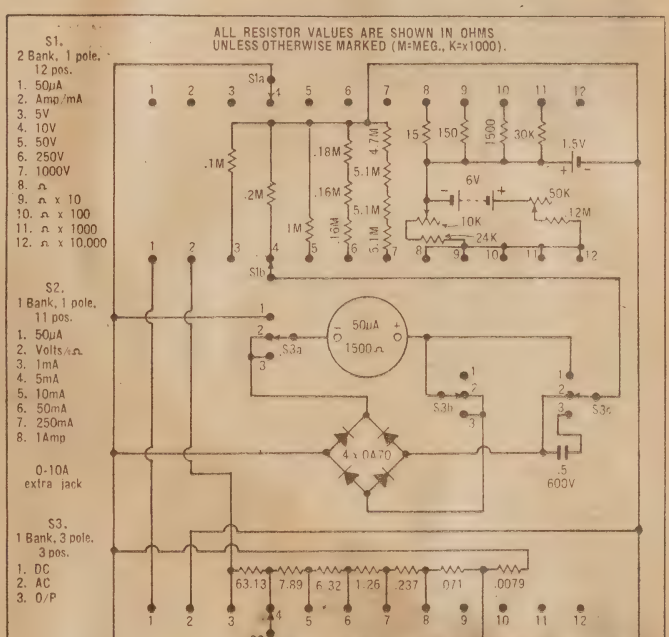


A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

A HIGH RESISTANCE MULTI-RANGE TEST INSTRUMENT

From Mr. W. H. Warner Shand of Lismore N.S.W comes information on a multimeter which he has constructed for his own use. It has a resistance of 20,000 ohms per volt full scale deflection and our correspondent feels that the additional cost over that for a 1,000 OPV meter is well worth while.



HE says: "I find that the instrument is a great advantage in measuring voltages from a high impedance source such as plate voltages, etc. It has an extra resistance range which covers from 0-10 megs. and I find it extremely useful as it brings most normal load resistances near the centre of the scale. The low ranges are useful for checking wiring faults in heavy duty equipment.

LOW BATTERY COST

"It is necessary to use high resistance values for the higher ranges and as far as I know resistances with 1 per cent tolerances above 2 meg. are unprocurable so I have used in place of the 5 meg. in the 250V range 3 resistors, two 0.16 meg. and a 0.18 meg. in series. For the 1,000V range, I have used three 5.1 meg. and a 4.7 meg. in series.

"The meter has a special scale which uses the same resistances for AC volts and DC volts so that only the addition of a rectifier is necessary to cover the AC ranges. I chose 4 x 0A70 in a bridge circuit because they were very satisfactory as well as being about the cheapest.

"Four ohms ranges are covered with the 1.5 volt battery enabling resistances up to 1 meg. to be measured. It requires an extra 6 volts for the range measuring up to 10 meg. I decided to use two pots so as to have enough control over the high range without making the low ranges too inaccurate with a flat battery. When both sets of batteries run down to about 75 per cent of their voltage they will have to be discarded which prevents too much of an error being introduced.

"It will be noticed that the high range requires only 7.5 volts total for operation. This makes the cost of batteries small in comparison with the 15 volts normally used. The maximum current drawn from the 1.5 volt cell is 100 mA and the 6 volt battery 50 uA.

"The resistances for the current ranges are connected in series in order to avoid a 2 bank switch. For the 10 amp range I used an extra jack, because the switches will not carry 10 amps without severe overheating.

"The meter has a F.S.D. current of 50 uA and a resistance of 1,500 ohms and obviously if a meter with different specifications is used, shunt resistance values will have to be changed.

"I built the instrument on a panel 6in x 9¼in and put it in a metal box of dimensions 6in x 9¼ x 2¼ which is comparatively small. With an engraved panel and a nice metal box the meter looks quite a professional instrument."

HIGH QUALITY INSULATION

(With high resistance multimeters it is most important to use switches and other components with high quality insulation since leakage resistances between adjacent switch contacts can cause serious errors. For example, a leakage resistance of 200 megohms between position 6 and 7 of the voltage range switch would cause the meter to read high by nearly 10 per cent. High quality ceramic switches are to be preferred and for the high voltage range it would be desirable to leave a blank space either side of the required position if a suitable switch is available.

METER SCALES

The meter with the special scales may prove something of a problem and it may be well worth your while checking with a manufacturer to make sure that the ohms and AC scales will work out properly. If you don't have special facilities it may be easier to get him to make the shunts for the current ranges than attempt to adjust them for yourself Editor.)

acos

A COMPLETE RANGE FOR EVERY PURPOSE

CRYSTAL MICROPHONES
MICROPHONE INSERTS

DESK or HAND MICROPHONE, MIC36

This Microphone is ideal for home recording and public address, etc. Response unexcelled for its size and price. The performance is not affected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. Recommended load resistance not less than 1 megohm, dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor, as required, at a small extra cost **PRICE, £6/18/6.**

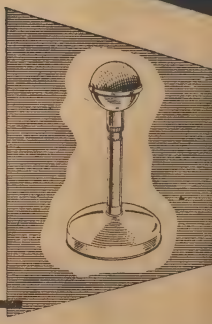
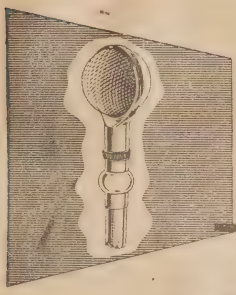


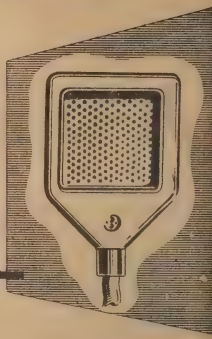
TABLE or STAND MICROPHONE, MIC22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the equation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost **PRICE £9/18/6.**



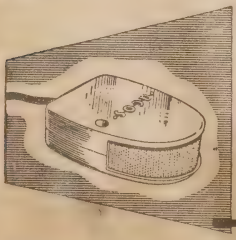
HIGH-QUALITY MICROPHONE, MIC16

This Microphone incorporates the world-famous floating crystal sound cell construction. Its fine performance is not affected by vibration or shock. The fidelity is not impaired by low frequency noise **PRICE, £24/19/6.**



LAPEL MICROPHONE, MIC28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft, moulded-rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel **PRICE, £5/19/6**

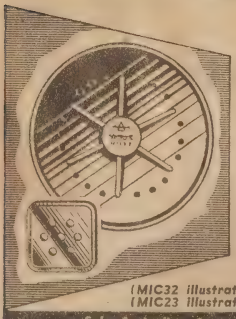


GENERAL PURPOSE, MIC35

The MIC35, is ideal for amateur transmitters, public address, etc. Housed in an attractive die-cast case, it features a high sensitivity and substantially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5,000 c.p.s. **PRICE, £2/15/-.**

HAND or DESK MICROPHONE, MIC33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. **PRICE, £6/18/6.**



CRYSTAL MICROPHONE INSERTS

These inserts are available in varying sizes, ranging from as small as ⅛ in. square to 1-⅛ in. round, with various thicknesses from ⅛ in. to ⅜ in. Suitable for every purpose, such as hearing aids, public address, tape recording, amateur transmitters, etc., they have responses from 2,250 c.p.s. to 3,500 c.p.s. at -5 db to -30 db. Insert can be supplied with or without 10 meg. resistor as required.

MIC19/4 and MIC32, **£2/15/6**; all others, **£1/19/6.**

(MIC32 illustrated)
(MIC23 illustrated)

Sole Australian Agents:

AMPLION (A'sia) PTY. LTD. 101 Pyrmont Bridge Rd., Camperdown, Sydney, N.S.W. Phone LA 6124.

Victorian Distributors: DISTRIBUTORS CORPORATION, 403 Bourke Street, Melbourne.

TRADE REVIEWS AND RELEASES

LEAK HAS NEW VARISLOPE III PRE-AMP.

Sent to us for test by Simon Gray is the latest pre-amplifier unit made by Leak, and known as the Varislope III. It has been designed to operate with the three Leak amplifiers, the TL/12, TL/25 and TL/50. It is larger and more elaborate than those which have been released in the past.

The Leak TL/12 Plus amplifier with the new Varislope pre-amplifier unit. Together they represent the best medium power equipment Leak has yet produced.

MOST impressive feature is the new styling, carried out in brown with old lettering, with a practical and balanced grouping of controls.

Full facilities are provided, and include connections for two pickups switchable from the front, radio tuner, and tape recorder. It is also possible to use a microphone connection by making a simple modification to the unit.

Separate gain controls are used on both the pick-up and radio inputs. These are pre-set at the rear of the unit.

A switch selector allows RIAA, NARTB, or the old standard LP curves to be selected, as well as a 78 position. Extra continuously variable bass and treble controls give plus or minus variations of 16 and 18 db respectively.

A roll-off filter, commencing at 9, 6, and 4 Kc, is included and, in conjunction with a Slope control to vary the rate of roll-off, gives a very wide range of control for use with sub-standard records.

There is also a rumble filter which reduces bass response at very low frequencies in case of rumble from the playback motor.

Instructions are given for the connection of a wide variety of pick-ups.

Two EF86 valves are used, and frequency control is obtained through the use of feedback circuits.

This is the most elaborate and best produced Leak pre-amplifier we have seen to date, and should be extremely popular for its versatility and performance.

The TL12 Plus amplifier which came with the Varislope performed appreciably better than its earlier counterpart. It has an EF86 amplifier, ECC81 cathode coupled phase splitter, and two EL84s in ultra-linear pushpull.

Its response was plus or minus 1 db between 20 and 50,000 cycles with a steep roll-off after 100 Kc. Maximum output was almost constant between 30 and 10,000 cycles, and there was very little ringing evident on a 5 Kc. square-wave test. Overshoot was negligible.

Only point of criticism was a tendency to supersonic oscillation at full output on very low frequencies, but this may have been caused by an abnormal output valve.

Both these units do justice to the high reputation of Leak products.

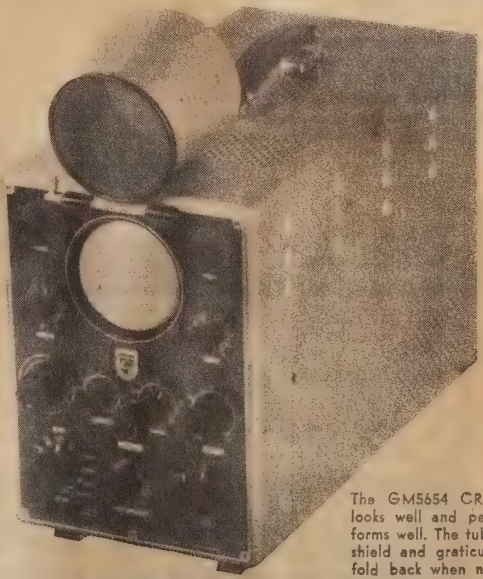
PHILIPS GM5654 TESTS WELL

A PHILIPS GM5654 4-inch oscilloscope was recently made available to us for review and we found the general performance and finish up to the excellent general standard we have come to expect from the Dutch Philips instruments.

Frequency response is between 1 c/s and 7 Mc/s, the gain being 6 db down at the latter frequency. The roll-off at the high end is apparently particularly smooth, as the instrument is able to handle fast-rise square waves with no noticeable overshoot.

A probe and a number of accessories including a camera stand are available for the instrument.

The price is £210, plus tax where applicable.



The GM5654 CRO looks well and performs well. The tube shield and graticule fold back when not required.

NEW RELEASE!

A. & R. CHASSIS AND TRANSFORMER KIT

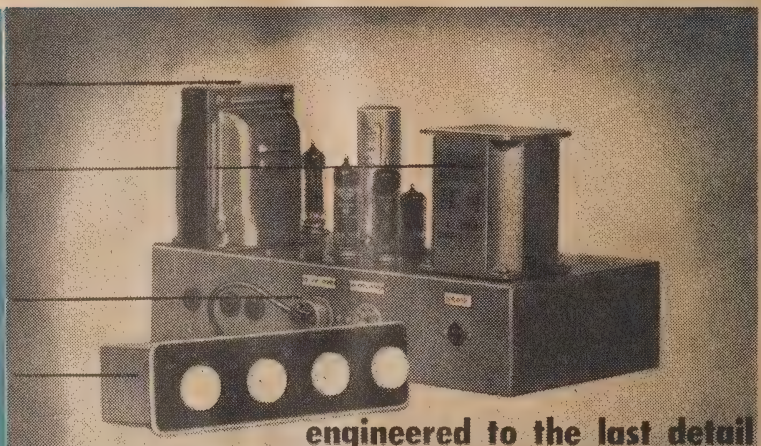
FOR THE MULLARD "5-10" AMPLIFIER!

POWER TRANSFORMER

OUTPUT TRANSFORMER

MAIN AMPLIFIER CHASSIS

PRE-AMP BOX



engineered to the last detail to give your '5-10' a professional appearance!

. . . ANY UNIT OF THE KIT CAN BE BOUGHT SEPARATELY

UNIT "A"
MAIN AMPLIFIER CHASSIS:

Comprising:—
Main Chassis.
Bottom Plate.
E.F. 86. Tube Shield.
1 Set Designation Stickers.
1 Packaged Set Plated Nuts.
Screws, Washers, Grommets, etc.
Chassis, Bottom Plate, Tube Shield.
Cadmium Plated and Passivated
Finished in Silver-Grey Hammer Tone Enamel.

UNIT "B"
PRE-AMP BOX

Comprising:—
Chassis and Cover.
E.F. 86. Bracket.
Front Escutcheon.
Full Length Registor Strip.
1 Set Designation Stickers.
1 Packaged Set Plated Nuts.
Screws, Washers, Grommets, etc
Finish:— As for Unit "A".

. . . ask your A. & R. Distributor for illustrated leaflet giving full details of wiring and assembly.

UNIT "C"
POWER TRANSFORMER

Type P.T. 1785 — 6.3v. Rectifier
Type P.T. 1786 — 5v. Rectifier

Ask your nearest A. & R. Distributor for Transformer Specification Sheet giving full details.

UNIT "D"
OUTPUT TRANSFORMER

Type 2525/8: for 2 or 8 ohms.
Type 2525/15. for 3.7 or 15 ohms.

. . . available throughout Australia!

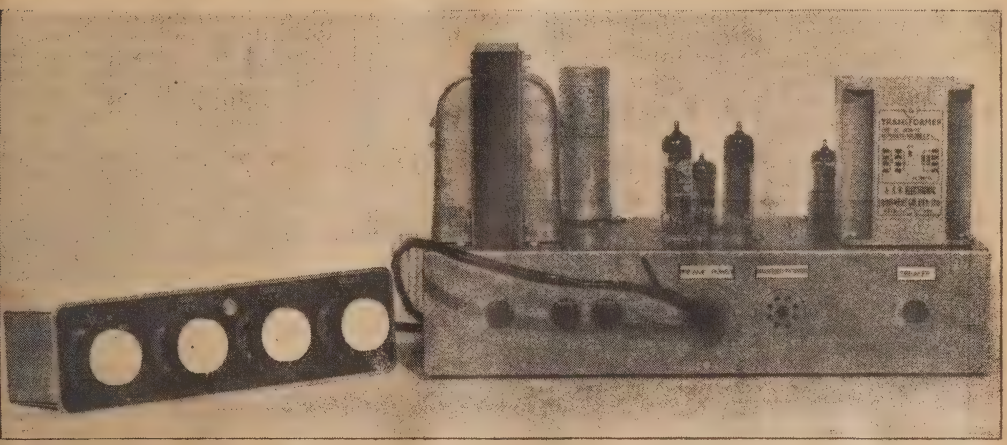
Home Constructors can now build the popular 5/10 the easy way! A. & R.'s Chassis and Transformer Kit eliminates those frustrating delays . . . saves you money! The general layout of the main Amplifier Chassis follows closely that shown in the Mullard Booklet "High Quality Sound Re-production." The Pre-Amplifier Unit has been re-designed, and both units allow the use of locally obtainable components.

MULLARD-AUSTRALIA PTY. LTD. COMMENT:— The workmanship and materials used in the Pre-Amplifier are of a high order and the lay-out open enough for the Home Constructor to have little difficulty, yet resulting in a compact, eye-pleasing unit It complies with all our electrical specifications and is, we feel, a unit which the Home Constructor could purchase with confidence, and would enable him to complete an equipment of both "Professional" performance and appearance!

DISTRIBUTORS: VICTORIA: Homecrafts P/L, J. H. Magrath & Co P/L, Radio Parts P/L, Warburton Franki, Motor Spares Ltd. STH. AUST.: Gerard and Goodman Ltd., 196 Rundle St., Adelaide. QLD.: A. E. Harrold, 123 Charlotte St. Brisbane. Messrs. Chandlers P/L., Cnr Albert and Charlotte Sts., Brisbane; Trackson Bros., 157 Elizabeth Street, Brisbane. W. AUST.: A. J. Wyle P/L, 1064 Hay St., Perth. TAS.: Homecrafts P/L, 220 Elizabeth St., Hobart. N.S.W.: United Radio Distributors P/L, 175 Phillip St., Sydney. Homecrafts P/L, 100 Clarence St., Sydney. AGENTS: R. H. Cunningham & Co., P/L, 16 Angas St. Meadowbank.

A. & R. ELECTRONIC EQUIPMENT CO. PTY. LTD.
378 St. Kilda Road, Melbourne, S.C.1 MX1150, MX1159

BASIC KIT SET FOR MULLARD AMPLIFIER BY A. & R.



Complete version of the amplifier built with A & R parts.

A & R are already well known in the audio field for the high quality of their audio and power transformers, which have been the basis of many good amplifiers. They have now come up with basic chassis kits which will enable a constructor to produce an amplifier with professional finish.

THIS parts kit has been prepared for use by home constructors intending to build a Mullard 5/10 amplifier.

All four items will be available separately and packaged accordingly.

MAIN AMPLIFIER CHASSIS, comprising: Main chassis, bottom plate, E.F. 86 tube shield, 1 set stickers (tube type, identification, etc.), 1 set plated nuts, bolts, grommets, etc., finish, chassis bottom, plate, shield, cadmium plate, and passivate; enamel, silver grey hammertone, outside only.

PRE-AMPLIFIER CHASSIS, comprising: Chassis and cover, E.F. 86 bracket, front escutcheon, full-length resistor strip, 1 sets stickers, 1 set plated nuts, bolts, grommets, etc. Finish, as for chassis Item A.

POWER TRANSFORMER: Type P.T. 1785. Suitable for both high and low loading conditions, with provision for the requirements of a tuner and pre-amplifier.

OUTPUT TRANSFORMER: A. and R. standard type O.T. 2525, available with 8 or 15 ohms secondary. Refer A. and R. Transformer Data.

BRAMCO MAKES CHOKES FOR AUDIO FILTER

BRAMCO RADIO PRODUCTS, of Wallsend, have long specialised in ductors and transformers for audio ork, and produce or can supply a large nge of such components for many irposes.

We have received from them a pair coils designed for use in the clipper

The Bramco filter inductors.

er circuit described in this issue. They a little larger than those we wound rselves, but should save the construc- a good deal of tedious work, and any ubt as to the accuracy of his finished l.

Bramco advise that they can supply ac- rate inductors under their trade name ve values of 140mH and 400mH. The e of these inductors is 2¼ inches in meter and 13/16th inches thick. The factors are particularly good, being ter than those we wound ourselves.

They can be fitted to our unit with a ght rearrangement of parts.

☆

Illustrated at the right is a tube of core locking compound currently being marketed by R. W. Steane & Co. Pty. Ltd., under the brand name "Q-Plus". The compound has the appearence of a thick grease but is not a grease and will not melt, even in a match flame. It appears to serve the purpose very well. Also illustrated are two toughened nylon alignment tools, which are finding ready use on radio and TV workbenches.

☆

Let's Buy An Argument

In the August and September issues, we engaged in a certain amount of verbal jousting with a reader M.G. on the subject of television viewing conditions. Having first counselled watching television in the dark, he seemingly relented somewhat, but said he still didn't like the idea of putting a shaded lamp near the receiver, as counselled by a large TV manufacturer's booklet. Neither did we!

by Neville Williams

SOME readers thought this way and some that, but most simply wanted to know more about it. This is understandable enough because, after all, eyes are pretty important things.

What looked like a chance to pick up some such information presented itself during the recent convention in Sydney of the Australian Optometrical Association, N.S.W. Division. One lecture set down, by J. Federer, M.Sc., was entitled "Visual Aspects of TV" and, on the strength of earlier remarks, I was invited to be present by an interested member.

As Liberace says . . . "Thank you. Ladies and Gentlemen: thank you so much. Thank you; Thank you Ladies and Gentlemen" . . . etc.

The "et cetera" is mine. Liberace is much more patient. He just goes on repeating himself.

Well, the first point that emerged from the lecture was that our ideas on ambient lighting were pretty close to the mark, at least as far as the lecturer was concerned.

He stated emphatically that the eyes should never be expected to focus for long periods on a small bright subject against an otherwise dark background. Most of us have been taught this in relation to books and reading lamps, but it obviously applies, with even greater force to television viewing, where the eye is looking directly into the source of light.

The lecturer classified the practice of viewing in the dark as a serious factor in producing eyestrain.

In point of fact, he suggested the provision of an ambient light level a good deal higher than one normally considers necessary—certainly higher than I normally use myself.

On the basis of an average screen brightness of 15 foot-Lamberts, which was adequate for good visual acuity, he suggested that the visual background within an arc of about 30 degrees should be about 10 foot-Lamberts.

Toward the limits of this arc and beyond it, the ambient light level could taper off but it should never be allowed to fall below 10 per cent of the screen brightness anywhere within the total field of vision.

In keeping with this requirement, it was necessary to consider not only the nature and position of light sources, but also the finish of the cabinet and the wall against which it is placed.

Dark masks surrounding the picture tube face and dark, massive cabinets are not a good choice, no matter how stylish they may be. Furthermore, the set should never be placed against a "feature wall" involving a heavy color, particularly if gloss finished.

WALL CABINET

A light mask around the picture tube, a light cabinet and a light pastel wall behind it were all significant in relieving the eyes from excessive contrast and consequent strain.

During question time, which followed the lecture, an optometrist quoted the case of a patient who had suffered persistent eyestrain from television viewing. Provision of carefully prescribed spec-

tacles and manipulation of lighting gave no substantial relief.

Relief was obtained only when a lightly-coloured plywood sheet, with a hole for the picture tube, was made up to stand in front of the massive, expensive—and dark—combination cabinet!

This is not my story. It's quoted as an observation from a qualified and practising optometrist.

LOSS OF CONTRAST

With a high ambient light level, picture contrast would seemingly have to suffer because light striking the screen must tend to "wash out" the black areas of the picture.

The effect is limited to a degree by the neutral density filter glass which forms the faceplate of most modern picture tubes. It can be augmented, if desired, by using a filter type safety glass although even ordinary "clear" safety glass will give some extra attenuation of ambient light.

But, in any case, our eyes help sustain apparent contrast to a surprising

degree. I remarked a couple of months back how the black areas in an active picture always seemed to be darker than the natural grey of the screen, viewed under the same ambient light, with the set switched off.

I put it down to pupil contraction, but Mr. Lederer suggested that it had much more to do with a phenomenon called "simultaneous contrast." A reference grey, seen against a white background, is always judged to be darker than when seen against a black background.

VISUAL EFFECT

Thus the neutral grey of an unactivated screen may appear much darker, even black, when integrated with highlights of an actual picture.

Regarding sources of light, Mr. Lederer stated as his view that the ideal was concealed lighting close to the ceiling and diffusing over the whole room, without reflections or strong shadows.

If concealed lighting could not be provided, conventional methods should be adopted, either in the form of overhead fittings, or table lamps or standard lamps.

Such lamps should always be located outside the field of vision but in such positions that there would be no images of them, particularly in the tube face or safety glass.

This last requirement was made easier to meet if the tube face and safety glass were inclined slightly downward at an angle of, say, five degrees from the vertical.

Viewing should be done with the head erect and preferably with the screen slightly below the level of the eyes.

Concerning viewing distance, the lecturer suggested that it is normal to sit at such a distance from the screen that the eyes just fail to resolve the line structure.

For the average viewer, this meant sitting at a distance from 6 to 8 times the screen diagonal measurement for a 625-line picture. At this distance, the picture subtends an angle at the eye of about 10 degrees, as compared with something like 30 degrees for a conventional theatre presentation.

LIMIT OF RESOLUTION

With such a comparatively small picture, the eyes are required, perhaps for long periods, to resolve detail representing about 6 minutes of arc, this being about the resolution limit for average healthy eyes.

As with any sense or function used to its capacity for a lengthy period, some degree of tiring is understandable. The lecturer pointed out that the average person might read a normal book for some hours without undue strain, but to read something with the print of a telephone directory for a similar period would be an intolerable experience.

Because of this rather onerous task, television viewing may discover visual imperfections which might otherwise pass unnoticed. Not the least of these has to do with binocular co-ordination, the ease or difficulty with which the two eyes can be brought to bear on the same small, distant detail.

As I listened to this portion of the lecture, I couldn't help but make a note on my pad for question time . . . "Why must one sit so far away?"

Is the line structure really so important? At the appropriate time, therefore, I raised the question.

It is an overstatement to say that we have a 625-line, 50-frame system. In conformity with overseas practice we use the interlacing principle to save bandwidth, and we get 50 frames or fields per second, each with less than half the official number of lines.

If an observer deliberately looks for lines, he can often see them over a surprising distance. In the first place, he's looking for them; in the second, by allowing the eye to rove around the picture area, it can catch on to the interframe strobing effect and be aware of the 300-line half-frame structure.

The idea of having a lamp within a television viewer's range of vision was queried in the September issue. Now an expert in visual problems has strongly condemned the practice. He says that the light source should either be substantially behind the viewer or concealed, even if behind the television set itself.

But having seen the lines from a certain distance, one way or another, he becomes a "statistic." Viewing distance is measured, averages taken, ratios worked out and the result is treated as something rather sacred.

May I suggest it's also rather unrealistic.

The average viewer is interested primarily in the picture. He isn't looking for lines, any more than he looks for the dot pattern in his newspaper illustrations.

UNDULY OBVIOUS

If he thinks of lines at all, it isn't on the basis of where they are just resolved but where they become so painfully obvious that they can't be overlooked.

So, just as casually as he accepts newspaper pictures with discernable dots, so does he accept television images with discernable lines. Ignorantly or otherwise, he transgresses the rules and ratios of the expert.

But here's the vital point: In doing so, he may almost double the angle subtended by the picture and any detail it has to offer, thereby relieving the eyes of some their arduous duty. What's more, he increases the angle through which they are likely to move, as they follow the action, getting away from the "fixed stare" induced by a small, distant picture.

In short, I'm inclined to think that the usual formula relating to viewing distance is too conservative. A more realistic figure for the average viewer might well be a distance of about four or five times the screen diameter, not six to eight times.

And I'd rather satisfy this requirement with a large screen viewed further away than a small screen viewed close up.

Quite recently I queried the head salesman in one of the city's largest television showrooms in regard to screen size and public preference.

As near as I can remember them, I quote his exact words:

"As long as there's 8ft between their eyes and the screen the public strongly prefer 21-inch sets.

"They know the picture isn't as sharp, but they still like it better."

Back of this there may be a good deal of desire to be "in the fashion," but I hardly think that one can write off public reaction entirely on such an account. If a large proportion of viewers find a bigger screen "easier to watch," then the stage is all set to get some local and up-to-date statistics.

LOCAL HABITS

I stress the word "local." We have a 625-line system in Australia, as against 405 and 525 in Britain and the Americas. Our viewing habits may vary considerably from theirs as a result.

What is the most preferred screen size nowadays? What is the average viewing distance? Can viewers see the lines from this distance if they look for them? Does the line structure worry them? What is the angle subtended at the eye by the picture at the preferred viewing distance?

Perhaps the average person buying a television set has a larger loungeroom than we have anticipated. Perhaps the 6 to 8 times formula is near enough after all.

The lecturer also dealt briefly with the subject of flicker and, here again, I was all set for an argument. It turned out to be something of a "phurphy," however.

He explained that any system of repetitive projection can produce a flicker sensation if the rate of picture presentation is too slow, the tendency to flicker being aggravated by high picture brightness.

On the basis of a 50 field system, the brightness available from a conventional television receiver in any likely condition of adjustment was below the flicker perception limits of the average viewer. Before optometrists became unduly concerned about complaints of flicker when watching television receivers, it was a good thing to be satisfied that the trouble was not, in fact, due to faulty receiver installation.

I began to bristle at this but it turned out subsequently that there was some

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misunderstanding of terminology, which might be a good thing for all and sundry to get straight.

Flicker, in the sense I have used it in these columns, has referred purely to the sensation experienced when the eye (and brain) fails to accept the rapid succession of images as a smooth, continuous picture. As mentioned earlier, it is a function of picture repetition rate, picture brightness and persistence of vision of the individual viewer.

Given certain transmission standards, there is nothing which can be done to a receiver to prevent the effect, nor do I know of any fault which will accentuate it.

If you happen to be one of the many other-than-average individuals who are worried by visual flicker, the only recourse is to reduce picture brightness and possibly contrast to the point where the trouble ceases.

FLICKER OR JITTER

Confusion occurs, however, when the same word is used to describe what might more appropriately be called "jitter" and this is a function of the receiver or its adjustment.

Marginal settings of the line or frame hold may produce jitter at the top or edges of the picture. Interference from the sound channel can cause flickering and bars in sympathy with sound volume and frequency. Microphonic valves can cause similar effects. Interference patterns from within or outside the set can appear. Line surges can cause change in picture brightness or size.

It seems to me that radio servicemen will be more concerned by such phraseology than optometrists, but, again, they brought the subject up! I can see, in this new sphere, a repetition of all the confusion which has hitherto surrounded the layman's use of the words hum, buzz, distortion, etc.

By way of general summary, the lecturer said that indications are that a small percentage of viewers do suffer eyestrain from watching television. This is evidenced by a tired feeling in the eyes, a tendency to lachrymation (production of tears) and frontal headaches.

It was due largely to lengthy concentration on a small subject, something which the individual might not otherwise do.

EXISTING DEFECT

More often than not, the effort merely brought to notice some visual condition which had thus far been ignored, and ordinary optometrical practice could correct it. Any other comparable visual effort would reveal the same shortcoming, so that the effect was not unique to television.

It was naturally important that the receiver be correctly adjusted, illuminated and placed so that the viewer could watch the picture without being subject to glare, excessive contrast or an unnatural viewing position, leading to visual discomfort. Again, this is a perfectly natural requirement.

Over and above these matters, there were two factors, he said, which might cause eyestrain unique to television. One was a rather intangible "novelty factor," which caused some disturbance until the senses grew to accept the different method of picture presentation. The same effect had been evident, on other occasions, when people were faced with some new visual experience—fluorescent lighting, for example.

The second stemmed from the fact that television tube screens have a predominance of blue in their light output. Eyes tend to focus in relation to the yellow portion of the spectrum and, due to the different wavelength and frequency, are slightly myopic (i.e., short-sighted) in relation to blue. Therefore, when the light output is predominantly blue, the eye fails to focus precisely and slight fuzziness and blurring may be evident.

The lecturer said that efforts had been made to correct this by the use of other phosphors or filters between the eye and the tube face, but, to the best of his knowledge, no one had succeeded in producing an economic combination retaining adequate light output with a smooth spectrum curve midway between daylight and artificial light.

TV SPECTACLES

Concerning television spectacles, the lecturer said he had not been convinced by claims made for any of the types he had seen.

Filter lenses, as such, did not appear to have characteristics which adequately complemented characteristics of the picture tube.

Spectacles with differently-coloured lenses were variously said to reduce flicker by reason of the different light transmission times and also to give a pseudo 3D effect. Some people seemed to like them but many others found them actively disturbing by reason of the "retinal rivalry" they produced, various portions of the picture erratically appearing in one colour or the other.

Neutral density lenses might bring comfort in some cases, but only in a negative way. If the picture or room lighting is of such an order to produce glare or flicker effects, the more logical step is to reduce the lighting and picture brightness—not hang a pair of spectacles on the nose!

The only obvious justification would be where one member of a family group, because of age or visual condition, demanded a brightness level which others found uncomfortable.

EXPERT OPINION

Such then, were the opinions expressed on this occasion by a recognised expert in matters visual. I say "on this occasion" because they may change as and when new data becomes available on Australian TV and Australian viewing habits.

And this leaves the way wide open for R.T.V. and H. readers to tell us of their observations. Again, I use the word "observations" quite deliberately because they are far more significant than mere expressions of opinion, based on hypothetical grounds.

And just by way of conclusion, will somebody please inform me how the use of germanium diodes in a television receiver can lengthen the life of the picture tube by 88 per cent?

What makes me ask such a silly question . . . . . if it is silly?

Well I read a statement to that effect in a current advertisement for a commercial television receiver!

I wonder would they also prolong the life of tubes used by the Water Board?

LIKES DIVIDED LOAD AMPLIFIER

Dear Sir,

Regarding Audio Amplifiers, which should come as a welcome change from television and all that.

I know we all have our (pet) idea on some subject and can't all be right, so here's mine, for better or worse:—

Divided load, or a cathode winding on the output transformer, to my way of thinking, offers far greater advantages than either Triode or Ultralinear operation.

Ultralinear for a start, from what I've read, doesn't reduce distortion, only breaks it up and shifts it up to higher harmonics. At lower output, percentage is higher than with other stages. This does not seem to be advantageous, as most of our listening is at low level.

Triode, which seems to be regarded as the TOPS, falls way short when I look at Radiotronics report on the Leak TL12. Third Harmonic Distortion at 10KC is 3.7% at 12 watts, but they go on to say that music would never provide such power at such frequency. How many ragtime amplifiers would look like class winners if we took this view?

Non-linear distortion is unquestionably reduced, but by how much, and at what cost?

There ends my condemnation of the aforesaid.

Divided Load, has comparable non-linear distortion to triode, is much better than UL. The THD figures are very good, stability (which is always an uncertainty with home constructors) is much more easily attained because of the low impedance of the cathode circuit. Filtration of the power supply is simple and less costly, (much less costly) and the output transformer just as simple as for Ultralinear.

This is the only thing in which I think you could have done much more. You did brush lightly on the system some years ago I know but a lot of water has passed under the bridge since then, and I for one would like very much like to see the cost go down and the quality go up. This, in one amplifier would be unique, and would create more interest than even UL did.

Divided Load is the only circuit which can do better than you already have. Try it and see and, if you don't agree, maybe I'll see this in the argument pages. All the best for a great magazine.

(D.F.)

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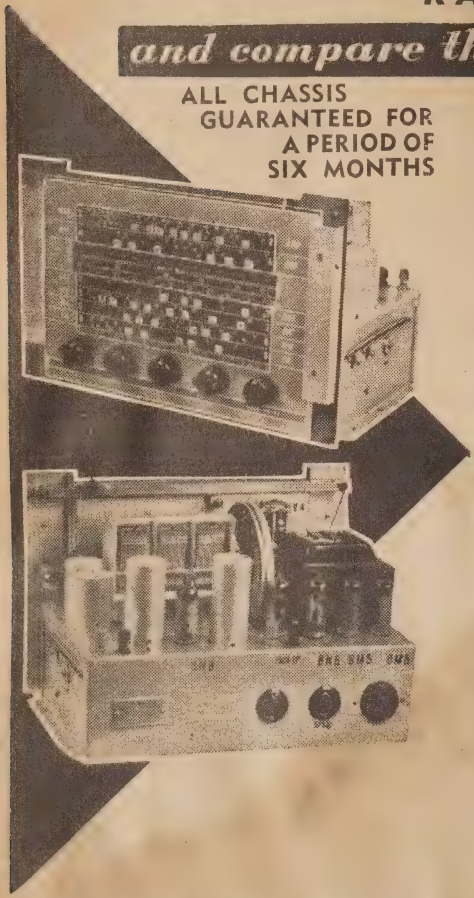

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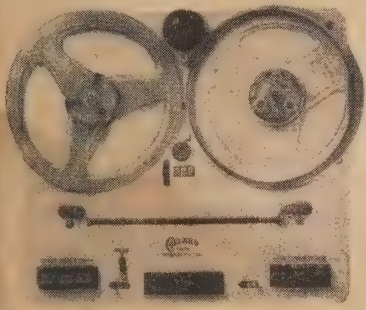

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  This has the effect of stopping the transit of the tape past the "Record/Play-Back" and "Erase" heads and applying the brakes to the spools whilst leaving all switches and mechanical functions in their selected position. Typical application is to pause whilst recording to omit speech interposed between musical selections. Control will only work whilst it is held in position.
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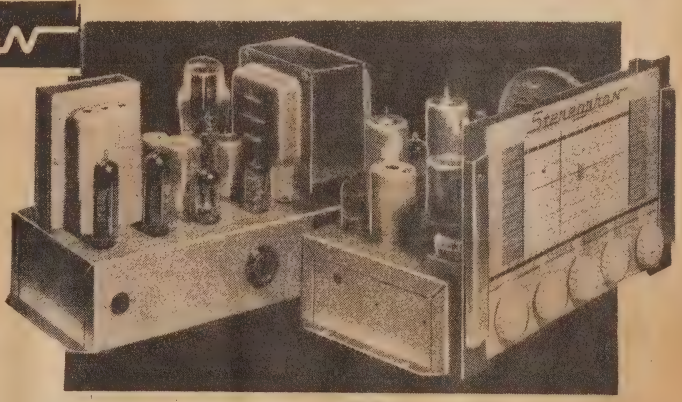

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OFF THE RECORD — NEWS & REVIEWS

Last month I made mention of the sudden interest in the stereophonic disc which has sprung up in America. This is the disc which carries two sound tracks in a single groove, and which played back with a pick-up to separate the channels and divert them to twin amplifier systems.

IN a recent issue of Audio Engineering, Edward Tatnell Canby, possibly the best informed writer on recordings in U.S.A., wrote an article which makes it clear he has much the same idea as I had, and from information which may have come from similar sources.

As far as I know no one has yet broken the ice—an event which he seemed to think is very close, or I'm sure he wouldn't have "stuck out his neck."

But I have heard further rumours which seem to indicate that there is very definitely something in the wind. You may remember that, when overseas last year, I was forced to believe that, sooner or later, someone would place the results of much experiment on the market.

This was in England, but in America I couldn't scare up any enthusiasm for the idea.

Now, almost overnight, the position seems to have changed.

Here's what Canby has to say:-

SAYS CANBY—

And now, having worked ourselves into a tizzy of excitement over stereo tape these last months, are we about to have a new explosion of major interest? Well, if it weren't so long between writing and publication, I'd stick my neck 'way out and say, looks like yes; but maybe I'd better play close. Rumours, just rumours, at this early stage of the game. But who knows what will have happened by the time this gets out, in September, that happy month of audio innovations.

Rumour has said, and said again (to get down to neck-sticking) that stereo is about to swoop upon us in a new form. Disc. Maybe it has, as of the time you read this. But in the deep, hot days of midsummer, back aways, I'm much too far from all the excitement to do any nosing around — and it wouldn't get me very far anyhow if I did; for if a "secret" were in truth let out in my direction, I'd have to shut up about it. Long as I don't know officially, I can guess all I want to.

LOW PRICE

So, out goes this long, long neck, a little ways. All I can say, first, is that if stereo disc does make a commercial break toward the public here, it will have to be a big break, and a low-priced one. No use fooling around with ultra-high-priced stereo discs. The disc has always been, and is more now than ever, a mass-adapted medium, basically easy to duplicate, easy to handle, sell, and play, and marketable at bottom prices. Nobody in his right senses, with tape on hand and so attractive, is going to throw in a new disc at tape prices. Not for long, anyhow.

And any conceivable stereo disc launched as I suggest on a big-time scale, would have to be as compatible as possible—which is a lot. Same general size and shape, same speed, and equally vital, the same range of playing time. (The old "binaural" disc with its two bands of grooves and two pick-ups fell down basically right here.)

Moreover, there should be compatibility, to some extent, between the stereo and standard disc playing. The stereo pickup—one pickup, of course, not two—should be able to play standard discs, just as a stereo tape player also plays non-stereo tapes.

LATERAL—VERTICAL

All of these things are already matters of fact in the recent British (Sugden) stereo pressings that use the lateral-vertical system. The Sugden discs look like ordinary LP's and are pressed like them, play as long. The stereo lateral-vertical pickup unit (two crystal elements hooked to a single stylus, if I have it right) will play ordinary LP records via its lateral element, presumably with the proper switching to send the lateral signal into both speakers. Same as the SINGLE (Monaural) position on stereo tape players.

(Lateral-Vertical systems aren't, of course, entirely compatible; an ordinary pickup would have a mighty rough time bouncing over the vertical bumps in the stereo record, especially those pickups with very low vertical compliance! Ouch, is all I can say, thinking of the mayhem that would be committed.)

The stereo disc, whatever system is used, is bound to be relatively low in price since pressing problems should logically be pretty much the same as with an ordinary record.

The dual equipment for preparation of the master is a relatively minor item of cost in the whole operation. (Indeed, stereo recording equipment for the tape masters is already in operation in almost every record company's studios.)

In fact I can't see how the stereo disc can be an economic problem at all. Everything is already there.

The major problem, of course, is the stereo system itself—which must work,

by John Moyle

and work well. The public you see, is not going to accept any stereo disc for long that means a compromise in actual sound quality over the regular LP record.

No matter that most people have cheesy "hi-fi" phonographs; if the word once gets around that a stereo disc is less good in quality, on the record than a standard LP, people will stay away from it in droves. And the regular LP record (maybe the 45, too) is going to be fairly hard to match.

Why else has stereo disc been stalling around ever since 1929? No sooner does a stereo disc system advance a bit than the standard record advances even more, and stays ahead in sound quality Has, at least, for these last 28 years.

So, the first public question that should be asked, as I see it, is "How does it sound? Is it as good as L.P.?" It had better be.

And a very important item in that sound is the stereo disc playing equipment. The stereo pickup, whatever system is used, will clearly have to be one-piece. One stylus. If there are two needles, then somebody's got to do some very tricky finagling and I'd like to be persuaded that it can be done — permanently and with commercial success' One stylus, please, or something that the public thinks is one and treats like one.

Come to think of it, there's no reason why, is disc stereo catches on, a whole range of playing equipment should not develop. The one important thing is that the records themselves, and entire system, allow for uncompromised high-quality sound.

HIGH QUALITY

Given that, given the potentiality for good sound, then, as in L.P., the equipment can be varied to suit the market.

Remember the original L.P. pickup, a crystal that played nothing above 6,000 cps.? But the L.P. record was better, and better equipment eventually appeared—still appears—to match it.

So should it be with stereo disc playing equipment, whatever type may appear at first. The stereo system itself must be inherently capable of L.P.-type sound quality, if disc stereo is to make a permanent dent.

I can go on to speculate that—the big IF having been satisfied, good quality —stereo disc could well be brought down to the over-all price of present standard disc. Stereo pressings are bound to be inexpensive. The stereo pickup can be made cheaply, with ingenuity and experience, though it would seem to be inherently more complex than the standard item.

POSSIBLE DEVELOPMENT

But, more significant, dual channel amplifying and speaker equipment is, I would guess, susceptible to a great deal of ingenious development aimed at producing two sounds for the price of one

Much of this is already on the books and more is obviously on the way. But bottom-priced dual amplification — with transistors?—is clearly a good bet. Stereo isn't really such an expensive proposition in these respects, when you come down to it. Why not two channels for the price of one?

A more problematical item is the speaker system, and, oddly enough, the cost of dual cabinetry looms as the most expensive item of all in stereo playing, for the masses.

RECORD REVIEWS OF THE MONTH

BRAHMS.—Symphony No. 1 in C minor. Played by the Pittsburgh Symphony Orchestra, conducted by William Steinberg. Capitol P-8340

As an example of straightforward Brahms, there is nothing much wrong with this record.

What it lacks to put it in the top class is subtlety.

Compare the second movement with Cantelli's earlier effort, for instance, with the Philharmonia Orchestra.

I admit it's a severe test.

But I'm sure you will appreciate the difference in touch, in atmosphere, in that beautiful sense of stillness which Steinberg isn't able to command.

Kubelik and the Chicago Orchestra also handle this movement better, and for similar reasons.

You will note how expressionless Steinberg appears in the first dozen bars when compared with these other two.

Then there is his handling of the horn solo, followed by the flute, near the commencement of the last movement.

How beautifully the nostalgic theme is given out by the Philharmonia, and how rightly the flute matches it in quality and mood.

The Pittsburgh players fail completely to understand the inter-relation of these passages, and the highly tremulous flute is merely an intrusion.

I could multiply these examples many times.

The best assessment I can make is that Steinberg has avoided the dangers of over-statement, but in doing so has severely limited his achievement.

It sounds good until you realise how well it can be done.

* * *

BEETHOVEN.—Sonatas Opus 31, Nos. 2 and 3. Played by Cor de Groot. Philips A 00204 L.

It's a pity this record had to follow Solomon's recently reviewed, which I thought so outstanding that I gave it five stars.

I haven't changed my opinion after hearing de Groot, but I feel he does much too good a job to be discounted by the comparison.

The difference between the two is most clearly shown in the "Tempest" movement of No. 2. In it, de Groot is much more forthright than Solomon. He plays with greater power and his contrasts are more marked.

But he is not as finished in either mind or muscle. Solomon's interpretation is highly personal, and for that reason some will not appreciate it if they don't like him.

His much greater sensitivity is clearly shown in many passages, such as the second movement of the No. 2, and in nearly all of No. 3, whether you like his quieter tone or not.

I get the feeling that he knows more about the music than de Groot. There is hardly a phrase which is played without its individual significance.

Only in the last movement of No. 2 did I appreciate his tighter approach.

Technically he is very clean and deft, and in this respect he is more enterprising than Solomon.

Despite all this, I have heard much worse playing from more famous men.

The piano is most realistically recorded, a bit hard in tone, but with good presence. A suspicion of wow on a few notes had me wondering about the integrity of my turntable, and I'm still not quite sure.

* * *

BEETHOVEN.—Symphony No. 5 in C Minor, Opus 67. Played by the Berlin Symphony Orchestra conducted by Karl Bohm. DGG 18 097 LPM.

This is a re-issue, I feel sure, but, despite its original release date of about two years ago, it does not lose much when its sound is compared with other versions.

I am hard to please about this symphony, which, I feel, must be played with the greatest vigor and drive.

I am quite prepared to countenance a rugged performance, provided it has this kind of animation and pressure.

Bohm does not come to life until the final movement. Elsewhere the performance lacks tension.

He has aimed at grandeur and dignity, but has added to it a touch of heaviness which I do not see in the work.

The opening chords of the final movement should burst upon us in a blaze of almost incoherent excitement.

Bohm gives them out as though they were a speech from the throne.

The music moves more freely toward the end, but there are others who in this regard do it better.

Only the most recent recordings might have sounded better, particularly in the bass end, although there is a tendency to overdo the bass in several cases.

If you want a high-pressure version, this one is not for you, but otherwise it stands up very well.

* * *

BACH—Concerto for Violin and Orchestra No. 2 in E Major.

BEETHOVEN — Romances for Violin and Orchestra No. 1 in G Major, Opus 40, and No. 2 in F Major, Opus 50. Played by Igor Oistrakh and the Gewendhaus Orchestra, Leipzig, conducted by Franz Konwitchny. DGG LMP 18 328.

These performances show Igor Oistrakh once again as a capable performer, deft and accurate, and with sure intonation.

The Bach Concerto is lively and tuneful, played with a brisk and sure touch by soloist and orchestra.

But the recording, as in the Beethoven romances, has a dull sound to it, almost as though there was some applied restriction in range.

It could be a matter of hall acoustics, which may also be the cause of an almost inaudible harpischord in the Bach.

An echo effect on the horns sounds as though they are picking up a resonance somewhere.

Am I imagining things, or is the violin a companion to that used by David Oistrakh? It has a middle register very much like it.

The Beethoven Romances are quite good, but there are some contemporary recordings which use a closer mike on the violin, highlighting the romance. Oistrakh is rather distant in his approach, although he plays them well enough.

* * *

BRAHMS—Symphony No. 2 in D Major, Opus 90. Played by the Berlin Philharmonic Orchestra, conducted by Euge. Jochum. DGG LPM 18 309

Jochum has been painstakingly through the score marking it with countless little pace changes, studding it with dynamic variations, and even periods of silence.

Some of the these are interesting, some are glamorous, and many are irritating.

Such things are only completely valid when they are natural contributors to the general shape, in which case they are noticed but do not halt the argument. They should not insert an unjustified dip in the interest curve or distract attention from the movement as a whole.

Otherwise we get a sensation as though a bird in flight suddenly halted in its

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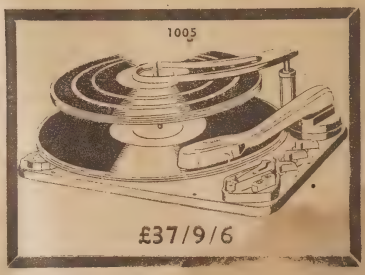

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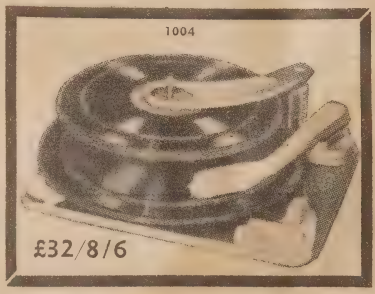

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tracks without losing height. It remains aloft, but we are distracted into wondering what keeps it there.

Jochum's general pace is measured and at no time does he reach a statement of real force.

But the record has many good points. The orchestra follows his mood admirably, and plays with sensitivity and grace.

The recording is typical DGG — not forward and yet with a good blend of reverberation and clarity.

Its long, sustained passages, as in the slow movement, achieve great beauty.

The bass is always present, although with less prominence than bass in other versions.

This is an individual recording of Brahms, and if you don't mind its eccentricities, you will like it.

The surface is OK, although not completely quiet. Cutting amplitude is moderate.

Why does DGG allow that awkward "whump" which occurs in the grooves between movements? It's a feature I have noticed in other discs, and should be ironed out in the engineering.

★ ★ ★

ESPANA — Bolero, Cappriccio Espagnol, Alborada del Gracioso, Triana. Played by the Hollywood Bowl Orchestra, conducted by Felix Slatkin. Capitol P-8357.

A good stock record, but I can't rate it more highly.

The sound has an airy, distant character which I would call shallow, although the quite considerable whacks on the drum are anything but remote.

I can't imagine that it was recorded at the Hollywood Bowl, for there is a distinct reverberation, but a good deal of the upper register seems to be going away into space.

The Cappriccio Espagnole I liked best, but I must admit that I cannot sit through a full performance of the Bolero. The only time I did so was during its first Australian performance in Melbourne, about 30 years ago.

Dynamic range is its most striking feature. It has this to a remarkable degree, but the louder passages sounded rather noisy to me.

I'll let you be the judge. The surface incidentally is very quiet.

★ ★ ★

BEETHOVEN—Concerto No. 5 in E Flat Opus 73 (Emperor). Played by Solomon and the Philharmonia Orchestra conducted by Herbert Menges. H.M.V. ALP 1300.

The only quarrel with this performance is that it isn't quite big enough.

After all it is the Emperor (although Beethoven didn't so name it) and calls for a powerful hand, at least in the first movement.

Solomon has a good conception of the music, but just lacks the strength to give it full size. At least he doesn't exhibit it.

The effect is heightened because the piano is remote by modern recording habits, not that I particularly dislike it that way but there it is.

There is no lack of brightness or drive. The first movement, particularly is kept going in an admirable manner. There are no disconcerting attempts to romanticise the tuneful bits or to play with the tempo just to be different.

If anything there is a tendency to overdo the briskness but there is no drooling.

Here is the true classical approach, with a mildness about the piano reminiscent of the rehearsal rather than a full performance.

Solomon's tone, as might be expected, is always beautiful, and his judgment in its use is almost without peer.

We hear it to advantage in the slow movement although the orchestra is rather too strong for the piano.

A greater contrast in dynamics could have been used here.

In the last movement, a sharper attack would have been better.

I have a weakness for an earlier Backhaus recording of this concerto for Decca, which plays well despite its age. Kempff made a good one for DGG but he isn't as good a pianist as Solomon. The sound is dull compared with this new record, on which it is best of all.

I'd probably choose it from the field. And you will probably like it the more you play it.

★ ★ ★

MOZART—Te Deum Laudamus, Laudate Dominum, Benedictus Sit Deus, Alleluia. Sancta Maria, Ave Verum, Inter Natos Mulierum, Kyrie Eleison, Quaere Superna, Jubilate Deo. Sung by the Strasbourg Cathedral Choir, Soprano soloist Monique Linval with the Strasbourg Chamber Orchestra conducted by Alphonse Hoch. Decca LXT 5310.

Some beautiful singing by the soprano is the highlight of this Mozart collection.

Her singing of Alleluia rings out clearly and with a delightful freshness.

She had a difficult job, or rather the recording engineers had, to overcome the tremendous echoes which are characteristic of these cathedrals.

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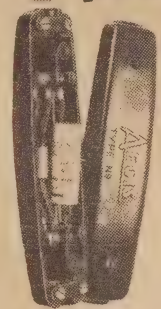

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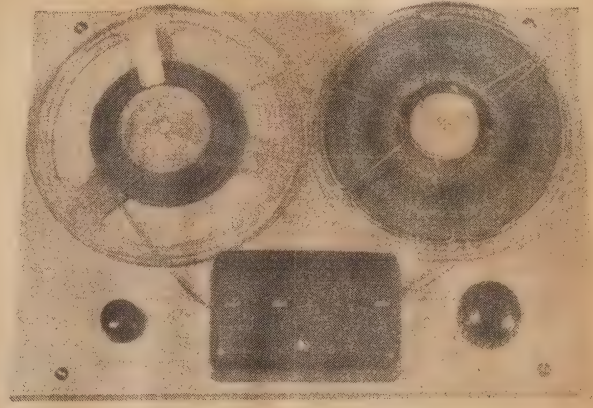

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There is plenty of opportunity to assess their time constant for yourself, if you can keep counting the seconds.

If therefore we approach this disc as a piece of recording, we must consider that a good deal of it is lost in the sonic overhang.

On the other hand, I suggest this music was largely intended to be sung in such places.

The succession of long held chords blend together to give a most vivid impression of actual presence.

The microphones have been so placed to make the most of the direct sound, guarding against what would otherwise have been hopeless confusion.

I have listened to similar music in such cathedrals, unable to determine accurately what was being sung, so mixed were the multiple sound paths over a distance.

Naturally some items are more successful than others, judged as recordings, but the quality of the singing and general performance makes up for that.

It's an unusual record of great beauty which has turned out much better than anyone has a right to expect.

★ ★ ★

BEETHOVEN — Overtures — Leonora No. 3, Coriolan, Prometheus. Played by the Philharmonia Orchestra, conducted by Nicolai Malke. Columbia ODLP 1061.

These performances are good enough but didn't arouse unusual enthusiasm.

The playing is good but there isn't much emotion, and one can't do justice to this music without tearing a lot of hair.

I felt it was being played by the head rather than the heart.

Much beating of air happens at the end of Leonora, for instance, but little real stature emerges, or imagination either, for that matter.

The Philharmonia has played these things so often it could hardly turn in a poor performance. It has already improved upon them for Karajan, although not grouped on a single disc.

I wasn't enamoured of Malko's rapid changes of tempo, which didn't always have the effect he apparently intended.

When he hurries, he scrambles.

The overtures are so well known that only an exceptional performance will do. This disc is good but not exceptional.

All the same, you'd have to buy several discs to collect better individual efforts, and this is undoubtedly a recommendation.

The surface has some clicks faintly audible on quiet passages.

★ ★ ★

STRAVINSKY — Le Rossignol, Lyric Opera in Three Acts. Conducted by Andre Cluytens. Columbia 33CX 1437.

This opera followed closely on the "Fire Bird" and "Petrouchka," and is freely touched with the Stravinsky idiom of the period. The story concerns the nightingale which sings each night to the Chinese fisherman, according to Hans Andersen's fairy tale.

The Chinese Emperor has it brought to his court, where all are enchanted with its singing. But the appearance of a mechanical bird, a present from the Emperor of Japan, is the signal for the bird to fly away, and for this it is banished from the country.

But, when the Emperor is dying, the bird returns, and so charms the Angel of Death that he restores the Emperor to health. The bird promises to return each night to sing.

The similarity of the orchestration to that of "Petrouchka" is most marked in many places, not forgetting the piano in the second act. You will also hear influences of Debussy and Ravel, particularly in the vocal parts.

These are clearly sung and recorded. I very much liked the balance of the whole thing—it is essential in such music for every note to be hard heard and in its place. The orchestra must be commended here—its proportions are just right.

Some greater variety in the voices would have brought some improvement, but if you are wise and invest in the book of words this won't bother you too much.

The surface is quite noiseless—I was mostly unaware of it. There is a suspicion of stress on an odd soprano note, but it's hardly worth mentioning. And all the singers are good.

High quality all round.

★ ★ ★

SULLIVAN—Overtures to Iolanthe and Ruddigore. Played by the Philharmonia Orchestra conducted by Charles Mackerras. H.M.V. 7EPO 7037.

No need to say more than that these are two of Sullivan's favourite overtures, superlatively played by the Philharmonia, and conducted by the composer-arranger of "Pineapple Poll," who should know his G. and S. if anyone does.

The recording is rather "light on," but it is lively, clean, and will undoubtedly set your foot tapping.

I played it with some bass boost.

★ ★ ★

SAINT SAENS—Symphony No. 3 in C Minor, played by l'Orchestre de la Societe des Concerts du Conservatoire conducted by Andre Cluytens. Columbia 33CX 1413.

Saint Saens wrote this symphony as a gesture to restore the reputation of French orchestral music, and he gave it all he had.

Whether that was enough to scale the heights is open to doubt. It sounds rather pretentious to us now, and with its large orchestra, at least for those days—piano and organ too—so it should.

There is a good deal of Liszt to be heard in it; Wagner and Franck are also represented. Note particularly the closing section of the poco adagio at the end of the first side.

It has seven sections, played without a break. This was a favourite idea of other Frenchmen of the day, notably Cesar Franck.

But none of his contemporaries succeeded in working so much into the score, although in justice we must recognise that Saint Saens has used his resources with the skill and judgement he undoubtedly possessed.

The finale is a strange mixture — it makes a great to do but has little to offer.

The task of blending organ, piano and orchestra is difficult, and there is a perilous amount of pure noise.

The recording isn't up to the standard I would have expected of a Grand Prix winner. It has little reverberation; it sounds rather empty and shallow, and I don't think the balance is outstanding.

It has the quality of the theatre rather than the concert hall. It lacks not weight but size.

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TO me the most interesting event of the month has been the release of some famous recordings of the past, re-recorded from their original 78 form to LP's.

Those received so far are Beethoven's first and fourth piano concertos played by Schnabel, the violin concerto played by Kreisler, and the Brandenburg concertos played by Adolph Busch and his orchestra.

I was quite amazed at the success of these efforts.

Most of them I heard many times in their original form, and remember them well for bad or for worse.

By worse I mean the imperfections of the Schnabel discs, for instance, where so often the reproduction suffered badly at the end of some discs.

And of course the surface noise, how about that?

Well, if you know the records well enough to anticipate the breaks, you can pick where one disc ends and the other begins. Once or twice this is so obvious that you wouldn't need your memory.

But apart from this point, there is no loss of continuity, and you soon lose the idea that there ever were 78 versions.

This is made all the more effective because engineers have worked wonders with surface noise.

They have apparently done this by repressing the records on vinylite or some such, and tailoring the response to remove anything not essential to the frequency range. There is no doubt that this is well down on modern records, but it didn't worry me as much as I anticipated.

So well has the technique succeeded that the surface noise is actually less than that on some genuine LP recordings now being issued.

Most of the distortion on the piano records has also gone, suggesting that it was due to the reproduction standards of the day, and the inevitable wear that went with them.

You need have no fears, therefore, that the re-creation process has not been successful. It is remarkably good, and the pleasure of hearing unbroken performances for the first time brings them a new value.

I do hope the venture succeeds here as it has done elsewhere, for, if it does, we will have available performances which richly deserve to be preserved.

All the discs are issued with special labels, and are packed in heavy jackets with a descriptive booklet. A plastic cover comes with each one—a valuable aid in protecting a valuable possession.

★ ★ ★

BEETHOVEN — Concerto for Violin and Orchestra in D Major. Opus. 61. Played by Fritz Kreisler and the London Philharmonic Orchestra, conducted by Sir John Barbirolli. (Recorded 1936.)

Kreisler's reputation and achievements have won him too many admirers for my own reactions to carry very much weight.

But I have never been an unqualified admirer of his Beethoven.

His playing has a tone and an emotional appeal which are undeniable, but I feel that he relied too heavily upon it.

His intonation, too, was never sure, and I am particularly sensitive to this uncertainty.

But whatever good qualities this recording originally possessed, they are only enhanced by the transfer to LP.

Without question, it will have a big following.

★ ★ ★

BACH—Brandenburg Concertos, played by Adolph Busch Chamber Orchestra, conducted by Adolph Busch. (Two records recorded 1935.)

There is a charm to these records which is all their own.

The limited frequency response is quite noticeable, as it must be when purely instrumental playing is concerned.

The dynamic range is also limited, and the only worth-while improvement I could make to the sound was to lift the bass.

Even so, it has a strange delicacy and there is no difficulty about appreciating the balance of instruments.

And there is a dedicated quality to the music which is not affected by the passage of years.

The contrast with some of the modern recordings of these concertos is very great.

But no one can escape their charm and sincerity.

★ ★ ★

BEETHOVEN—Concerto No. 4 in G Major Opus 58. Played by Artur Schnabel and the Philharmonia Orchestra conducted by Issy Dobrowen. (Recorded 1946.)

BEETHOVEN—Concerto No. 1 in C Major Opus 15. Played by Artur Schnabel and the London Symphony Orchestra conducted by Sir Malcolm Sargent. (First recorded 1932.)

To my mind, these are the most rewarding and valuable of those I have heard so far, and make me most eager to hear the rest of the Beethoven discs it is intended to release.

Schnabel's Beethoven has become a legendary thing, and many who did not hear it have wondered if in fact it was so good.

I'm sure the performance of the fourth concerto in particular will provide them with the answer.

Hearing it again showed me only too clearly what has been missing in more modern versions, good though some have been.

Schnabel's complete mastery of the music, mentally and technically, is evident in every bar.

His playing transcends the mechanical, it is as though we were following his thoughts and not his hands: we are aware of and admire what these are doing, but they are merely a means to an end.

An odd handful of wrong notes would not necessarily break the spell, so complete and powerful is the continuity of his musical conception.

And yet it is by the strength and beauty of his playing that these things are communicated: by the exquisite shaping of each bar or group of bars, by the inevitable logic of his argument,

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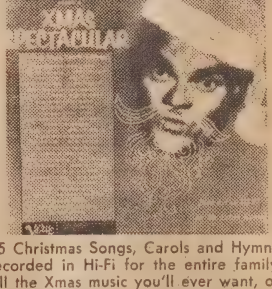

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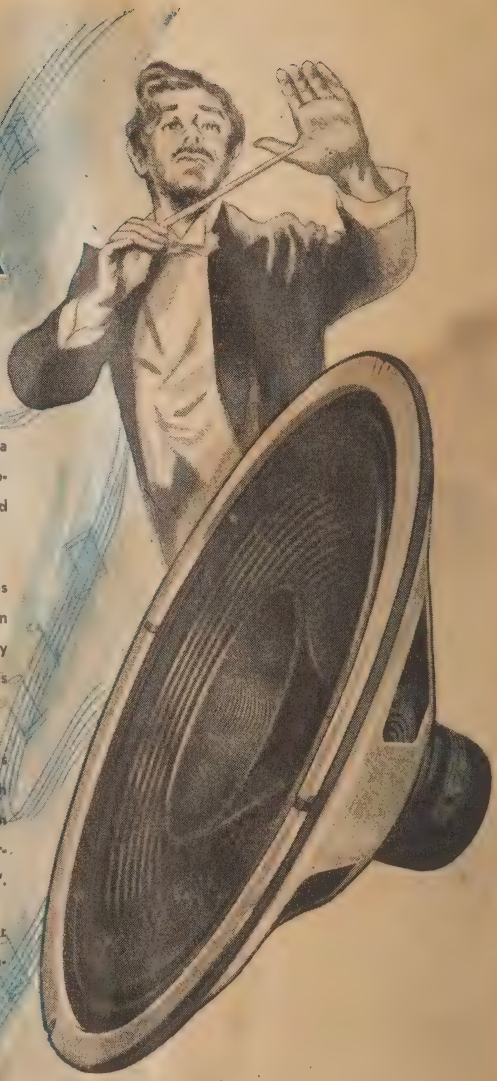

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and the tremendously satisfying authority with which he goes his way.

To my mind, no other Beethoven pianist can compare with him. He is the master; there is nothing in the music he has not solved, and he shows us how it should go with the greatest fluency and ease.

With all the limitations carried over from our yesterdays, I will always come back to these records for the magic that is in them.

Once you have become used to the limited tones of the orchestra—the piano is surprisingly good in No. 4 — you won't be seriously disturbed by it. Because of this limitation it is hard to assess the quality of the players, but my impression is they are not as good as the orchestras of today.

Any lover of music for itself will not be able to do without some of these Schnabel records.

* * *

DVORAK—Quartet in F major Opus 96 (American); Quartet in E flat major Opus 51. Played by the Budapest String Quartet. Coronet KLC574.

Good to see more of the Budapest records. There are quite a few of them which may have got mixed up in the change of labels and were not released.

The most attractive side to me is the "American," maybe because I know it best and because on the whole it is more worth knowing.

It was written some time after the Opus 51, and belongs to the "New World" era, the flavour of which is heard all through it.

This is the mood which has produced Dvorak's most tuneful and most immediate music.

The Opus 51 has some fine passages, but it lacks the artlessness which makes Dvorak so appealing.

The recording is quite forward and the instruments balanced to give good ensemble. Some might even wish for greater first violin prominence, but that is the Budapest's way.

It has no sharp edge or forceful personality as heard in some other modern quartets.

In manner it is warm and intimate, musicianly and rarely aggressive.

I liked it best with a notch of extra bass to lift the cello a little. He is worthy of special mention for his excellent work.

A few spots of groove echo were the only recording flaws I could hear.

* * *

BEETHOVEN—Quartet No. 14 in C Sharp Minor Opus 131. Played by the Hungarian String Quartet. Columbia 330CX 1442.

This is one of the Hungarian's most successful Beethoven recordings.

It is perhaps easier to find points of disagreement in works of lesser stature than in this, one of Beethoven's most profound works.

There is still the tendency to press on regardless, which marks most of the quartet's playing. Maybe I'm becoming conditioned, but I did not find the tempos as disturbing as in the past.

On the contrary, I appreciated the vitality and drive, and the care with which both were used.

The opening movement could be the most difficult thing in all Beethoven's music, and without adequate understanding it can become an impossible travesty.

I did not think the Hungarians found its full intensity, and there could have been a greater contrast between the first two movements had the players been more deeply absorbed in the wonderful closing section of the first.

This sudden change of mood can be tremendously effective.

And it's the kind of contrast I believe to be essential if this extraordinary musical landscape is to be explored and illuminated to the full.

Once again I must praise the completely distinguished performance of these men, their smoothness and certainty, their precision and clear outlines.

These things stand them in good stead during the complexities of the fourth movement, where greater freedom might have been used in developing the variations.

But this is a fine issue. The recording quality is much the same as for the earlier records in the series, and I know of no version more authoritative and successful.

WHAT AUDIO EQUIPMENT DO I USE?

(Continued from page 89)

through a home-made crossover network of standard design, using a series choke for the middle speaker to damp down a rise about 4 Kc which is typical of most speakers of this type.

The tweeter I have found most efficient, and the output is clean enough to run it full on, although variable output controls are used in the crossover network. I am a believer in diffused sound. I do not like the middle and high horn technique, at least in my room, and so I tilt the cabinet holding the smaller speakers so that it points about 45 degrees upward.

Played this way, it never sounds oppressive, a most important point when one is obliged to spend hours on end listening to a procession of new releases.

I have my reservations about the use of crossover networks on principle, but I cannot devise a better way of splitting up the sound other than using multiple channels which so far I haven't tried. But here I am getting into a big subject, and had better leave it at that.

I have another enclosure which I frequently use when trying out single speakers, or co-linear types, but somehow I always come back to the multiple types arranged in much the manner I have described.

My room is an irregular shape, but I always mount the speakers in one corner at the short end, and as far away from me as I can get them. Turntables and equipment are in a small cabinet near the listening position.

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D2E	200 ohms	1mV	15mV	—
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SHORT-WAVE NOTES BY ART CUSHEN

ANGOLA OPENS MANY NEW STATIONS

An increase in the number of stations in Angola is reported this month, while news of other new transmitters in Bolivia and Mexico is included.

Angola

THE new stations which are operating in this country are: CR6RI, Radio Andrade, Andrade, on 4,977 Kc, 3.00-4.30 a.m.; CR6RR, Radio Cassanguidi, Cassanguidi, 4,824 Kc, with 60 watts, 3.00-4.30 a.m.; CR6RS, Radio Maludi, Maludi, 4,841 Kc, 60 watts, also 3.00-4.30 a.m.

Other stations operating included CR6RB, Radio Eciesia, Luanda, on 7,079 Kc, or 11,469 Kc, 1Kw, 3.45-6.30 p.m., 8.00-11.00 p.m., 3.30-7.00 a.m.; Radio Club, Quanza Sun, CR6RP, 7,820 Kc, 200 watts, 3.30-8.00 a.m.; Radio Clube do Sul Angola, CR6RK, now operates on 3,603 Kc, 750 watts, 9.00-11.00 p.m. and 3.00-8.00 a.m.; Radio Clube de Malange, CR6RE, 7,244 Kc, 200 watts, operates 4.00-5.00 p.m., 9.00-11.00 p.m., 3.30-7.00 a.m.; Radio Club da Huila, CR6KH, on 5,022 Kc, 1Kw, 4.15-5.15 p.m., 9.15-10.45 p.m., 4.00-7.00 a.m.; Radio Clube Mocamedes, CR6RM, 7,300 Kc, 300 watts, 9.00-11.00 p.m., 3.30-6.00 a.m.; Radio Clube de Bie, CR6RO, 7,582 Kc, 300 watt, 4.15-4.45 p.m., 9.30-10.30 p.m., 3.40-6.30 a.m.; CR6RA, Lobito, 7,038 Kc, 100 watts: 4.15-5.00 p.m., 9.30-10.45 p.m., 6.00-7.30 a.m.

BOLIVIA

Stations now operating in this country are: CP39, 4,855 Kc, 6.30-noon; CP5, CP6, 5,975, 9,500 Kc, 9.00 p.m.-2.00 p.m.; CP18, 6,070 Kc, Radio el Condor, Oruro, 9.00 p.m.-3.00 a.m., 8.00 a.m.-2.00 p.m.; CP15, 6,125 Kc, Radio El Congor, La Paz, schedule as CP19, CP30, Radio Grigoto, Santa Cruz, 10.00 p.m.-1.00 p.m.; CP12, 6,150, 9.00-11.00 p.m., 2.00-4.00 a.m., 8.00 a.m.-1.00 p.m.; CP40, 6,160, 7.00 p.m.-10.00 a.m.; CP9, 6,185, 9.00-11.00 p.m., 9.00 a.m.-2.00 p.m.; CP37, on 6,190 Kc, Radio Oruro, 10.00-11.00 p.m., 8.30 a.m.-1.00 p.m.; CP3, 9,555, La Paz, CP21 on 9,570 Kc, 10.30-midnight, 1.00 a.m.-3.30 a.m., 7.30 a.m.-8.30 a.m., 10.30 a.m. to noon.

MEXICO

XEEW is now the callsign heard on short wave outlets of XEW, and is beamed to Northern Mexico and U.S.A., on 15,160 Kc, and 9,500 Kc. Stations operate 9.45 p.m.-4.00 p.m.

The shortwave outlet of XERC operates on 6,135 Kc, 9.00-4.00 p.m.; La Hora Exacta on station XETT, 9,550 Kc, 1 Kw, operates 24 hours a day except Monday, 1.30-2.00 p.m.; XEBT on 9,625 Kc, operates, 10.45 p.m.-4.00 p.m.; Station XEQQ, 9,680 Kc, is off the air, 9.45 p.m.-4.15 p.m. XEX programs are relayed on shortwave by XEXF, 9,535; XEXG, 6,065; XEXE, 11,900 Kc.

New Manila Transmitters

NEWS on the installation on the transmitter site at Bocaue has been received from Norman Blake, of the Far East Broadcasting Company, in Manila.

The building for the new 50,000 watt transmitter is about completed, and it will be only a short time until laying out the floor area in trenches for the transmitter installation.

In the work on which the FEBC is engaged, finance plays a very important role, and it is not always possible to proceed as quickly as any Government operated station, reports Mr. Blake. In Okinawa, the installation of the other new station, which at present uses 1,000 watts, on 1,020 Kc, is going along slowly. Tests are being made. The station is using the callsign KSAB, and installation of the 100,000 watt transmitters has not been started at the Okinawa site.

BEC24, Taiwan

THE schedule of this seldom heard station has been released by Radio Australia, and with its extended hours of operation, BEC24 should be within the listening range of radios in this area. The station operates 8.10-11.00 a.m., 1.30-4.30 p.m., 7.30 p.m.-2.30 a.m., using 9,510 Kc.

New Swiss schedule

THE broadcasts from Berne in common with all European stations are on a new schedule for our summer, and the stations are employing frequencies from the 11 to 49 metre band in their services to various parts of the world. The service to the Australian and New Zealand area from Berne is from 5.15 to 7.00 p.m., and is on 17.784, 25.640 and 11,865 Kc, and to Western Australia, 7.00-7.45 p.m., on 11.865, 17.784 and 25.640 Kc; 10.45-12.30 a.m., on 15.305, 21.605; 12.45-2.30, a.m., on 11.865, 21.605, 17.784, 21.520; 2.45-4.30 a.m., on 17.729, 11.865; 4.45-6.30 a.m., on 9.665, 7.210; 11.30-1.15 p.m., on 11.865, 6.165, 9.535, 9.665; 2.15-3.00 p.m., on 11.865, 9.665, 9.535. All programs are in English.

> Reports from listeners should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are Australian Eastern Standard Time.

MOZAMBIQUE transmissions from Lorenco Marques are received at good strength in West Australia reports Cyril Anderson of Mt. Hawthorne who finds signals on 4,920 and 3,242 in English, and the Portuguese outlet on 4,842 is received at 6 a.m. A further English language transmission has been noted on 3,265 Kc, which is not shown on a recent verification card from the station. This station announces as "Radio Club of Mozambique" as against the normal announcement of announcing "This is Lourenco Marques." Salisbury has also been noted on 3,396 Kc when closing at 6.15 a.m. at fair strength. Tokio Home service on JKH on 7,257 Kc is reported from West Australia opening at 6.00 a.m. at fair strength.

FLASHES FROM EVERYWHERE

LONDON'S broadcasts to the Pacific area are now being streamlined, and the two programs for this region, the Pacific Service and the General Overseas Service will in future be carried on the same frequencies. The broadcasts of the G.O.S. at present are 4.00-6.00 p.m. and the Pacific Service from 6.00 to 6.45 p.m. Listeners will not now need to tune to other frequencies at 6 p.m. as in the past. The two services are at present carried on 11,860, 11,955, 15,310 and 15,440 Kc. The present gap in the G.O.S. from 6.00 to 7.30 p.m. is expected to be filled on December 29 when the G.O.S. will again be on the air for 24 hours each day instead of the 21 hours a day at present.

EDMONTON station VE9AI which we reported logging last issue, has confirmed reception of the broadcasts on 9540 Kc and states that the power of the transmitter was recently increased to 200 watts from the power of 100 watts as in the past. The station is still being heard opening at 11 p.m., and reports should be sent Chief Engineer, CJCA-VA9AI, Edmonton, Alberta.

SWEDEN in this new schedule for the summer months adds some new frequencies and the complete transmission plan is as follows for the broadcasts in English. 10.30-11.45 p.m. on 9.620, 15.240 Kc; midnight-12.30 a.m. on 17.840; 12.45-2.00 a.m. on 9.620, 15.240, 2.15-3.30 a.m. on 11.705, 17.840; 3.45-5.00 a.m. on 11.705; 4.45-5.45 a.m. on 9.620; 6.00-7.00 a.m. on 7.210; 7.15-8.45 a.m. on 11.705; 9 a.m.-10.30 a.m., 9.620, 11.705; 10.45 a.m.-1.00 p.m. on 11.705, 10.45-noon on 11.810; 12.15-1.30 p.m. on 9.620, at 4.30 to 5.00 a.m. on 9.335 Kc.

TANGIER is the home of the new Norwegian program called Radio Norea, Grensen 19, Oslo, which has programs over the Voice of Tangier at 4.30 to 5.00 a.m. on 9.335.

TIRANA broadcast on 6.910 has moved to 9,610 Kc and has the normal news session at 6 a.m. which unfortunately is not the present local and national news as seen from the capital at 4.30 to 5.00 a.m. on 9.335.

TIDCR, La Voz de Victor TIDCR, Radio International, La Voz de Costa Rica, San Jose is the announcement used for this station, whose mailing address is Apartado 3.411.

The station has moved from 9,615 to 9.625 Kc and uses 4,000 watts. TIDCR opens at 9 p.m. and has been heard to sign off at 4 p.m. on Sundays.

GUATEMALAN station TKQA, in Quesaltenango, has opened a further transmitter on 11.710 Kcs, with the call sign TGQB. The stations TGQA on 6,110 Kcs with the power of 1,000 watts operates 10.55 p.m.-2.00 p.m. and this is also the schedule on TGQB on 11.710 Kc with 500 watts.

ECUADORIAN broadcaster HCJB on November 1st increased its schedule to seven days a week for listeners in the South Pacific area, the normal silent day of Tuesday being dropped. The station now operates to the South Pacific on 9,745, 11,915 and 15,140 from 7.00 p.m.

DAMASCUS has dropped its normal two-hour broadcast to Europe, reports the World Radio Handbook, and now transmitts from the Syrian capital on 15,165 Kc. The session of one hour duration is broadcast now from 5.30-6.30 a.m., with English news at 6.15 a.m.

BRITISH GUIANA station ZFY Radio Demerara, in Georgetown in confirming a report from a listener in the United States, states they operate on 9,445, 5,981, 3,255 Kc, and are on the air Sunday, Monday, 7.45 p.m. to 12.45 p.m. next day, Friday and Saturday from 7.15 p.m. to 12.55 p.m. Other days the transmission is 7.45 p.m. to 12.45 p.m., but on Sundays the transmission is at times extended to 1.45 p.m.

MONROVIAN station ELWA which broadcasts from Liberia has been logged in North America in the special transmission on 9,650 Kc from 12.05 to 12.45 p.m., SUDAN transmission from Radio Omdurman, Khartoum, on 4,972 Kc, are still heard with the English broadcast from 2.00 to 2.30 a.m. The station has been slowly dropping in frequency, having been heard here in the past few months on 5,010, 5,000, 4,990 and now 4,972 Kc.

ROME Radio with the 24-hour watch for ships at sea has been heard by Arthur Harris, Benalla, Victoria, on 12,365 Kc, from 3.00 to 6.00 p.m. The station announces in Italian and English and is best 3.00 to 3.30 p.m. and 5.00 to 5.30 p.m.

JOHANNESBURG transmissions on 25,800 Kc has been reported by Graham Hutchins, of Melbourne, at good strength during the normal daily broadcast from 9.00 to 10.00 p.m. This transmitter is of only 1,500 watts and seems to provide good signals in most parts of Australia although in New Zealand it is rarely received. The peak period for reception on the 13 metre band is now with us and several other signals, mainly from Europe are being received in the late evenings at good strength.

INDONESIAN STATIONS

The recent changes in Indonesian stations are featured in this list of frequencies and powers in use, as supplied by Radio Australia.

BANDOENG: YDA1, YDA2 (2420), 250w; YDA3 (4845), 10,000w.

DJAKARTA: YDB (2420), 1000w; YDB2 (4910), 300w; YDB3 (7270), 7,500w; YDB4 (3935), 7500w; YDD (3277), 1,000w; YDE (11,770), 7,500w; YDF (6045), 100.000w; YDF2 (9710), 50.000w.

SOURAKARTA: YDG (4880), 10.000w; YDG2 (7240), 1.000w.

MADIUM: YDG6 (3287), 300w.

SEMERANG: YDH (2490), 1.000w; YDH2 (3259), 5.000w.

SOURABAYA: YDI (3355), 1.000w; YD12. YD13 (3980), 10.000w.

JAMBA: YD16 (2330), 300w.

PADANG: YDL2 (2480), 1,500w; YDL3 (6170), 1Kw.

BUKITTINGGI: YDM (3232), 1w; YDM2 (5030), 5Kw.

KOTARADGA: YDN (2399), 1Kw; YDN2 (4985), 1Kw.

BANDJARMASIN: YDO (3250), 10Kw; YDO2 (5970), 1Kw.

MEDAN: YDP (4830), 7½Kw; YDP2 (2990), 250w; YDP3 (7195), 20Kw.

MAKASSAR: YDQ (3325), 250w; YDQ2 (4750), 3Kw; YDQ (7295), 20Kw.

AMBON: YDR (4865), 10Kw; YDR2 (3241), 1Kw.

MANADO: YDS (3214), 5Kw; YDS2 (5990), 1Kw.

DENPASAR: YDU (4840), 10Kw; YDU2 (3395), 150w.

PONTIANAK: YDW (3375), 1Kw.

SUNUNEP: YD13 (2370), 150w.

TDJANONG PINANG: YDX (3232), 100w.

SAMARINDA: YD (3295), 150w.

TURNATA: YD (3325), 250w.

SIBOLGA: YDM6 (3241), 350w.

TJIREBON: YDA4 (2420), 1.000w.

The Overseas service is transmitted from Djakarta and uses the following stations: YDF2 (11.770), YDF3 (11,795), YDF4 (17,810), YDF5 (7220), YDF6 (9710), YDF7 (11.770), YDF8 (9865), YDC (15.150), YDC (7,126).

All reports should be sent to Radio Republic Indonesia, P.O. Box 7, Djakarta, Indonesia.

JOGJAKARTA: YDJ (5,060), 7,500w; YDJ2 (7,100), 20,000w; YDJ3 (2.350), 10,000w.

PALEMBANG: YDK (4,855), 10,000w; YDK2 (2420), 1.000w.

THE HAM BANDS WITH BILL MOORE

Conventions are a very necessary part of amateur radio activity and practically every week one is held in some country centre in Australia. Amateurs travel long distances to take the opportunity of meeting each other personally—they have often been friends over the air for years.

OVER 60 amateurs, XYLs and juniors attended the W.I.A., N.S.W., South Western Zone's Convention held at Coolamon in October. Amateurs attended from as far afield as Gosford.

The convention was officially opened by State W.I.A. president Peirce Healy, VK2APQ, at the dinner held in the R.S.L. hall on Saturday evening. He was accompanied by Councillor Norm Beard, VK2ALJ.

Results of the field events and competitions were as follows:—

Saturday 144 Mc/s Hidden Transmitter: First, Keith Dodd, VK2ZAA; second, Ross Weeden, VK2PN.

Scramble: First, Ross Weeden, VK2PN; second, Stuart Savage, VK2PL.

Sunday 144 Mc/s Hidden Transmitter: First Keith Dodd, VK2ZAA; second, Geoff Page VK2BQ.

Blindfold 144 Mc/s Hunt: Ladies — First, Mrs Jim Edge; second, Miss B. Druitt. Gentlemen—First, John Smith; second, VK2NV.

The "Amateur" Hour saw Stuart Savage, VK2PL, adjudged the most popular contestant—he played the bagpipes. Second, T. Simpson with his violin and third, R. and J. Weeden, piano duet.

Treasure Hunt: First, J. Weeden; second, H. James; third, E. Clare.

Only casualty of the convention was Don Haberecht, VK2RS, of Albury, who after travelling halfway developed spots and returned home with the measles.

Those attending were enthusiastic on the general arrangements and success of the convention. Credit should go to zone officer Jim Edge, VK2AJO, and his wife and to secretary Stan Abbey.

The ITU conference

DISCUSSIONS held to date in W.I.A. circles favour the sending of a credited amateur radio representative from Zone 3 to next I.T.U. conference to open in Geneva in July, 1959.

In view of the Atlantic City reductions in the size of some of our bands it is considered that amateur radio should be fully organised to oppose any further limiting of our bands.

Demands for additional frequencies by other services in the intervening years have been increasing and amateur societies will have a difficult task to ensure the retention of the current bands.

Federal W.I.A. secretary Doug Bowie, VK3DU, will next year leave on a world tour and have the opportunity to discuss the proposal of sending a representative with officials of other national societies.

During the trip he will be able to talk with members of other Zone 3 societies in Malaya and Siam, and also with the R.S.G.B. and Continental associations. The W.I.A. is fortunate that Doug will be able to gain first-hand information of the views of the I.A.R.U. bodies on the proposed Zone 3 representation.

The problem of financing such a venture is, of course, a major one, the estimated cost between £1,500 and £2,000. The delegate would have to reside in Geneva for some months to allow coverage of all items discussed and likely to affect amateur radio interests.

The raising of such a sum is not impossible if one remembers the solo effort of Jim Corbin, VK2YC, who raised over £1,000 toward the erection of Station VK2WI at Dural. General comment of amateurs supports the sending of a delegate to Geneva.

Some have expressed their willingness to contribute toward the cost. If each amateur contributed 10/- it would be sufficient and an excellent investment if it would assist in the retaining of the current amateur bands.

PARIS CONFERENCE

The Paris conference of the VHF managers of various amateur national societies in Europe brought forward some interesting ideas of future VHF activity on that continent.

The usual idea of operating on the lower end of the bands for CW operation and DX was by by arrangement reversed and the portion of the band 145.8 to 146.0 MC/s has been reserved for DX working. This section of the band is generally unoccupied and ideal for such working.

The main problem will be to ensure that this portion of the band is always covered during tuning. The region's VHF Bureau will issue a certificate for the longest distance covered on each band each year.

Four Europe-wide VHF contests will also be arranged each year. It was suggested that the scoring be recorded on a points per mile basis but long-distance checking accurately would be intolerable and a zone system for points score was adopted.

The REF, the French society, defrayed the cost of the convention, and delegates from 14 nations attended.

International Year

INTERNATIONAL Geophysical Year amateur radio activity in Europe has provided many excellent contacts on the VHF's during special world intervals. Quite a number of QSO's have been recorded between English amateurs and those on the Continent during Auroral conditions with the beams pointed northwards.

The special world intervals are initiated as soon as unusual solar activity is observed and considered likely to cause magnetic storms. Scientific observation is then intensified to record the maximum possible amount of data.

The first effect of a solar flare is to affect the properties of the ionosphere causing short period radio fadeouts up to half an hour or so on the HF bands.

Some 24 to 72 hours later the ionosphere is bombarded by particles released by the flare giving rise to many effects. The most interesting to the VHF operator is the aurora. Simultaneously, interruption of the properties of the ionosphere causes further radio fadeouts on the HF bands.

News of warnings of special world intervals is broadcast by a number of stations besides WWV. They include WWVH, Hawaii, on 5, 10 and 15 Mc at 14½ and 44½ minutes past the hour, from JJY, Tokyo, on 4, 5, 8, 10 and 15 Mc at 14 and 48 minutes past the hour and LOL, Buenos Aires, on 5, 10, 15 Mc.

To further information on aurora reflections being recorded a number of stations have been set up by national amateur societies and beams are pointed north. The R.S.G.B. operates GB3IGY on 144 Mc with 1 Kw input.

Denmark operates OZ7IGY on 144 Mc, Poland SP5FM, 5IL, 3PK, 2DX on 50, 70 and 144 Mc, and Yugoslavia YU1AO on 72 and 145 Mc.

A further subject for study by amateurs has been suggested by Dr. Briggs, of the Cavendish Laboratory, Cambridge, that of listening for long delayed radio echoes from signals in the 3-30 Mc section of the spectrum. These echoes are believed to come from streams of ionised particles from the sun and this study fits in with amateur I.G.Y. observations.

The echoes are delayed by approximately 1 to 10 seconds and must not be confused with the "round the world echo" of approximately 1/7 second.

The long delay echoes are much rarer and it is possible they will occur during the early stages of a world interval. There have been reports of echoes occurring on amateur signals but the most favourable prospect would be from high power commercial CW signals.

Few reports of echoes of long delays have been received in recent years. They were first observed in 1927 and are known as Stormet echoes. The work at that period was done between 10 and 12 Mc. With the crowded spectrum these days it is generally difficult to hear the original signal free from interference and special signals may have to be transmitted to afford satisfactory observations. Both the 14 and 21 Mc band could provide echoes and reports should be forwarded through amateur I.G.Y.

NATIONAL FIELD DAY STARTS JAN. 26, 1958

THE WIA's National Field Day 1958 will be held as usual during the Australia Day weekend in January. The object is for operators of portable and mobile stations to contact other portable, mobile and fixed stations both within their own State and in other parts of the Commonwealth and its Mandated Territories.

The contest will run from 00001 hrs. to 2359 hrs. east on January 26 and operating time Transmitting open, (d) Fixed stations working to hours during the above period.

The contest is divided into five sections (a) Transmitting phone, (b) Transmitting CW, (c) Transmitting open, (d) Fixed stations working to portable and mobile stations, (e) Reception of portable and mobile stations.

The following is a summary of the major rules:—

Power is limited to an input power with aerial connected of 25 watts to the final stage and must not be obtained from either public or private mains.

Portable or mobile stations shall not be located within a radius of one mile from the home QTH.

They shall not be located in any occupied building or dwelling.

Apparatus shall not be set up earlier than 24 hours before the commencement of the contest but can be moved from site to site during the duration.

Any number of transmitters may be used but only one at any time.

Cross-band operation is not permitted and one contact per station per band is allowed.

More than one operator may participate in the operation of mobile or portable stations, provided all operators are licensed operators.

The usual contest cyphers must be exchanged before points may be claimed, they comprise RS or RST report plus the accepted three figure arrangement.

Entries must be postmarked not later than February 15, 1958 and addressed to the Federal Contest Committee, WIA Box 1234K, G.P.O., Adelaide, South Australia.

Scoring: Portable and Mobile Stations. One point for contacts with fixed stations within the Commonwealth, five points for contacts with other portable or mobile stations in the same State. Ten points for contacts with mobile or portable stations outside of the competitors own State.

Fixed and receiving stations. Two points for contacts (or logging) with portable and mobile stations in the same State. Five points for contacts with portable and mobile stations in the contest outside of the State.

The following constitute call areas: VK1 (A.C.T.) and VK2 combined, VK3, VK4, VK5 (S.A.), VK5 (Northern Territory), VK6, VK7, VK9. Logs should be set out in the usual form plus information on all the operators, location of station and hours of operation.

Locations of stations contacted should also be shown and portable and mobile stations must include a brief description of the equipment used and power input.

Certificates will be awarded to the highest scorer in each section and additional certificates will be issued if the entries warrant it.

In the case of a winning station being manned by more than one operator, each operator will receive a certificate provided he has contacted, at least 25 per cent of the stations submitted on the log.

The receiving section is open to all SWL listeners in the Commonwealth. They will log only the serial number sent by stations and that station's call sign. CQ's should not be logged and a station may be logged only once for each band.

DX ON VHF IN VK4

With the release of the 50-54 Mc band to Australian amateurs for the duration of the I.G.Y. it was not long before VK's were contacting Japanese stations on the band.

As previously VK4 stations were in a better position to communicate with the JA's, and Vern Kerr, VK4LK, soon had recorded over 20 contacts. In N.S.W. both Bob Godsall, VK2ARG and Hugh Stitt, VK2WH, worked two JA's. Interstate openings were common even short skip working to VK3. It will only be a matter of time before John Peell, VK2WJ's contact with the U.S. is repeated.

VK4 amateurs received a considerable amount of useful publicity in the way of photos and news items for their work in following the signals from "Sputnik" in October.

The VHF section's October hidden transmitter search was won by Jack, VK4JO, the location in the Cannon Hill area.

It is hoped soon to arrange a VHF field day would those interested please contact Jack VK4JO, or Mick, VK4ZAA.

Best wishes to Ron, ex VK4ZAN, who now signs VK4RG on obtaining his full ticket. The location at Mt. Crosby was not the best for 144 Mc so Ron will have a better chance on the other bands.

A good signal on 144 Mc should soon emanate from Gympie where the gang are working on a 100 rig.

The above VK4 notes were contributed by John, VK4ZAG.

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The CQ contest

THE CW section of CQ magazine's world-wide DX contest will run from 0200 GMT, November 30 to 0200 GMT, December 2. Serial numbers to be exchanged include RST report plus the zone number in which the station is located i.e., N.S.W., Queensland Victoria and S.A.—30 and W.A.—29.

Three points are scored for contacts between stations in different continents, one point for contacts with stations in the same continent.

Contacts between stations in the same country score no points but may be made for the purpose of zone and/or country multipliers.

Only one contact with the same station on one band counts for points. A multiplier of one is allowed for each zone contacted on each band and a multiplier of one for each country worked on each band.

Entries which should be postmarked not later than January 15, 1958, should be sent to the Contest Committee, CQ Magazine, 300 West 43rd Street, New York 36, N.Y., U.S.A.

Charles Maclurcan

ON October 26, Australia lost one of its amateur radio pioneers with the passing of Charles Maclurcan, VK2CM. In the twenties 2CM was one of the best known personalities in radio despite the fact he was never engaged in the industry.

2CM's programs from Strathfield entertainment on the broadcast band, was listened to and enjoyed by many Australians. 2CM later A2CM then OA2CM on the short waves was to become one of the best known call signs in the world.

He was a foundation member of the N.S.W. division of the WIA and later elected a life member of the division. Charles was operating during the opening of the short wave bands for world-wide communication and was the first amateur to contact a number of countries.

In the late twenties he ceased to take an active part in the hobby but in 1947 started a second session of amateur operation. With his usual thoroughness he erected a beam for 14mc/s to talk with his many American friends made during world trips.

Charles station was beautifully equipped and one of the multiband transmitters was presented in 1956 to the Institute for use at VK2WI Dural. In recent years his interests in the hobby mainly centred on scheduled talks with his many friends among the older amateurs. The 80 metre band was the centre of activity.

Charles Maclurcan, VK2CM, will be missed by his many amateur friends who cannot forget his bright personality and his contributions to radio and they extend to his family sympathy in their loss.

Central Coast Radio Club

THE Central Coast Radio Club was foundeo at Gosford, N.S.W., on Friday October 18 and 37 persons attended the opening meeting.

Local member of Parliament, Mr. Roger Dean, was elected as patron. President of the new club is well known amateur, Major Collett, VK2RU, and secretary is Reg Brooks, WIA associate of disposals distribution fame.

Four members of the N.S.W. W.I.A. council attended including State president Peirce Healy VK2APQ.

The practical side of the hobby was emphasised at lectures given at the October meeting of the N.S.W. division. Norm Beard, VK2ALJ, described and demonstrated the variations required to make a TV tuner cover four amateur bands as a convertor. Max Sobels, VK2OT, using an old AR7 chassis described the modifications required to make an effective "AT7" transmitter from the receiver.

Joe Reed, VK2JR, explained the workings of a transformer designed to match co-axial cable to open wire lines.

Finally Bob Godsall, VK2ARG, received his trip down to the Civil Defence School at Macedon Victoria, and explained the reasons for the new name for WIA emergency nets — WICEN (Wireless Institute Civil Emergency Nets). The old name clashing with official Civil Defence Nets.

Mr Gordon Pattison, well known CSIRO officer lectured on "The Expanding Universe" to the November meeting of the N.S.W. VHF and TV section. It was stated that he had practically converted some of the VHF gang to telescope viewing. Another November lecture was delivered to the Hunter Branch of the N.S.W. division by Joe Reed, VK2JR his subject "Sputnik."

The tape presented over VK2WI on crystal grinding recorded by John Miller VK2ANF was a demonstration of the value of a practical discourse.

John covered all aspects of grinding and the revival of crystals out of oscillation, the information was of great value to anyone contemplating regrinds. More of these types of talks would be very welcome.

The leading DX stations in the U.S. have a very systematic approach to methods of working the rare DX stations. A number of them have exchanged lists of prefixes they have not contacted and have reciprocal arrangements whereby they will telephone one another if any of the missing prefixes are heard—the telephone call to be billed against the amateur called.

Perhaps this is one of the reasons why on the appearance of any rare prefix it is only a short time before the big W DX exponents are in operation.

DX during the VK/ZL HDX contest in both Telephony and CW stations was the best recorded for many years and station participating were busy writing their logs for contracts on 14, 21 and 28 mc/s.

The 21 mc/s band was heard at its best and for practically the whole of the 24 hours duration of the contest DX stations could be worked. Scores should be higher than for many years, it was a pleasure to operate under such conditions.

If you contacted HV1AA around November 27 there is a chance that the station will be legitimate according to W6GKK—the HV station would operate for two to three days. There have been so many false stories in the past on proposed Vatican City amateur activity it would appear that a QSL card must be received as confirmation before one could be certain of listing a new country.

The Tamworth Radio Club held its first annual meeting in October and Merv Findlay VK2ATD was elected president, Secretary Gordon, VK2WY, treasurer, Bruce Holland, VK2ZAD, and publicity officer, Ken Scott.

A.O.C.P. CLASS

The W.I.A., Victorian Division, A.O.C.P. Class will commence on Monday, 3rd February, 1958. Morse and Regulations are held on Thursday and Theory on Monday evenings from 8 to 10. Persons desirous of being enrolled should communicate with the Secretary W.I.A., Victorian Division, 191 Queen Street, Melbourne (Phone MY1087 from 9 a.m. to 4.30 p.m.), or the Class Manager, on either of the above evenings.

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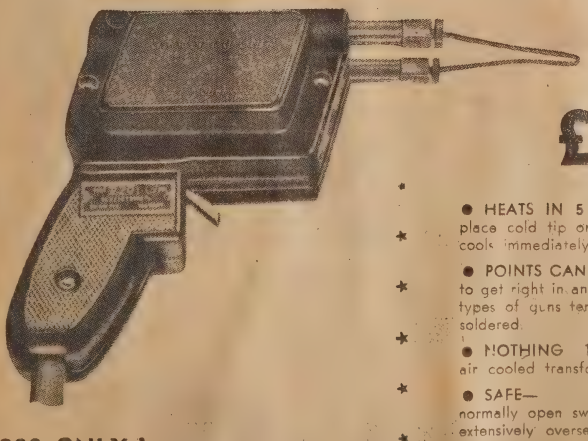

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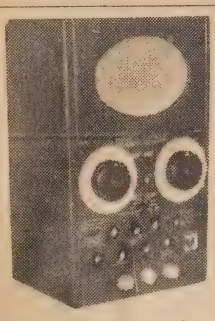

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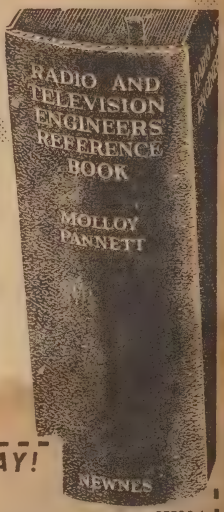

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THE SPACISTOR

(Continued from page 7)

charge somewhat like that in a vacuum tube.

This charge exists to some extent throughout the semiconductor, but is much heavier in the area marked SC. In this area, particularly, moving charges are speeded by high voltage across the spacistor body.

So the problem of speeding up the charge carriers is solved. All that remains now is to get some charge carriers to speed up.

We also have to control our stream of charges so as to get amplifier action. The tungsten-wire contact marked INJECTOR supplies the charges. It is connected to the base through a battery (BATT. 1) which biases it slightly more negative than that part of the base with which it is in contact. Therefore it emits electrons into SC, the space charge area. The flow of electrons from the injector is limited by the backward pressure of the space charge, as in a vacuum tube.

The MODULATOR is placed a little farther along the body of the spacistor and is also biased (with BATT. 2) to be somewhat more negative than the area under it. But it is doped with a little p-type material, and thus forms a p-n junction with the underlying semiconductor. Since its bias is negative, it can emit no holes into the base and therefore draws no current.

INPUT SIGNAL

The input signal is applied between the modulator and the base. The modulator acts like the grid of a vacuum tube; changes of voltage on it vary the current from the injector. The DC bias voltage on the modulator also makes it act something like the screen grid in a vacuum tube. The field due to this voltage is felt through the whole space-charge region and has a greater effect on the no-signal current from the injector than does the voltage from BATT. 3, across the whole spacistor.

Thus it tends to prevent the injector current from being affected by changes in the voltage between base and collector. This keeps the output impedance reasonably high—in excess of 30 megohms for an injected current of 30 mA. (The input impedance is likewise high—also about 30 megohms.)

The spacistor is still in the early experimental stages and has not yet been tested to the limits of its capabilities.

No checks at very- or ultra-high frequencies have been run, and the full amplifying power of the device is still unknown.

Low-frequency power gains of 70 db. and voltage gains of 3,000 have already been obtained from experimental units. Transconductance of present spacistors is considerably below that of good vacuum tubes, but is comparable to that of dry-cell types.

The spacistors' output capacitance is extremely low—values of less than 1 uuf are entirely feasible—and it is expected that amplifiers can be built to operate at frequencies higher than 1,000 Mc.

—RADIO ELECTRONICS.

SOUNDS NOT ALWAYS WHAT THEY SEEM

(Continued from page 19)

peculiar muffled effect is obtained of two persons talking to each other on a telephone when both parties are present in the one studio.

At one time this effect was gained by wrapping the microphone in a towel, or some such. Then it was found that a telephone sounded like a telephone because it failed to transmit certain sound frequencies.

ELECTRONIC FILTERS

To use the electronic filter the engineer merely plugs the device into the microphone circuit. All sounds then coming over the circuit can then have any frequency boosted or attenuated as required by the script. This device is used in plays where the sound is supposed to come over the radio, telephone, phonograph, police station and so on.

This apparatus is also used to produce those "spooky" tones used by ghosts, the inner voice of conscience and supernatural beings of all sorts.

Another device is the "thunder screen" that gives a most realistic effect of thunder. It consists of a tightly stretched copper gauze screen to which is attached, by means of a wire inserted into the needle-holder, a magnetic gramophone pickup. When the screen is struck with a mallet the resultant vibration produces a current in the pickup head, which current is fed into the transmission system. If the initial blow is followed by several lighter blows the diminishing effect of the thunder roll is very realistic.

Despite the recorded and electronic devices now used by the S.E. man, he is still dependent on many pieces of apparatus which he has to "cook" up himself.

He can make a squeaker by finding a rusty hinge and mounting it on two blocks of wood. Another type consists of a dowel, which can be turned, around which is a pad of leather which can be tightened with a spring. When the dowel is turned it squeaks on the leather.

An elevator door opening and closing is simulated by rolling a roller skate up and down some metal channel with a block of wood at one end. When the skate contacts the block of wood it sounds like the door closing.

There is a sound like "Boooiiinnnggg" when someone snaps a wire. This is produced with a "Boing Box." It is a small wooden box with a wire mounted on an extension just like a one string fiddle only the extension is flexible. When the string is plucked and the flexible extension or neck bent the string is tightened with a resulting increase in pitch producing the characteristic "boooiiinnnggg."

A punch on the head can be made by striking a pumpkin with a mallet. A falling body is well simulated by dropping a melon from a ladder on to a concrete slab.

Boiling water is produced by blowing through a drinking straw into a glass of water. Rattling bones are sounded by suspending dowel sticks by string from an upright support. Moving the supports allow the dowels to hit together.

A piston aeroplane engine can be "sounded" by allowing a piece of paper to contact the revolving blades of an electric fan.

Hail is simulated by pouring rice from a height on to a piece of slanting glass. Rain is imitated by rolling a few dried peas around a flat tin pan.

The sound of wind is made by removing the blades of an electric fan and replacing them with four thin dowel sticks about 18 inches long.

A monkey's squeak is made by rubbing a smooth bottle with a wet cork. A heart beat is imitated by placing a needle of a record player on a few thicknesses of felt or sponge rubber. With the volume turned full on, the felt or rubber is tapped with the finger at the required beat.

Crackling ice is sounded by crumpling the outer cartons of electric light globes. Squeezing and twisting an inflated rubber balloon with the fingers imitates a ship in an ice jam.

These are only a few of the many hundreds of schemes used by the sound effects technician to produce the sounds required in a radio play.

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The 122 transceiver covers a frequency of 2 to 8 Mcs. and has been approved by the P.M.G. for use on fishing boats, small craft, bush fire brigades etc.
These sets are supplied complete with valves, 12v. vibrator power supply, dynamic headphones and microphone, 6in x 9in. ovaltone speaker, leads, spare kit of valves and two crystals to required frequency. Range to 300 miles. Sets air tested. **£40.** F.O.R. These units in new condition.

The 122 transceiver as above but less crystals, speaker and spare valves not air tested. **£18.** F.O.R.

The 22 transceiver as 122 but not converted for crystal control, supplied with valves, meter, power supply, dynamic headphones and microphone. **£15.** F.O.R.

Transceiver only supplied with valves and meter.
£5/15/ F.O.R.

No. 19 TRANSCEIVERS

These units cover a frequency of 2 to 8 Mcs and contain 15 6.3 volt valves including 1-807, 2-6V6, 6-6K7, 2-6K8; 6B8 etc., also 500 micro-amp meter.
Units supplied complete with valves, leads, junction box, genemotor power supply and dynamic headphones and microphone (operate from 12v supply). Air tested.
£16/15/ F.O.R.

Set of leads and junction box for No. 19 Transceiver **20/** plus post and packing 10/. 12 volt Genemotor for 19,
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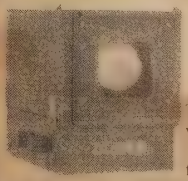
These meters can easily be converted to 10 or 100 mA. meters, new scale supplied with meter. 7/6 Post 2/6.



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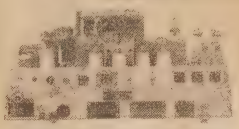

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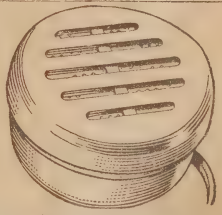

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AMERICAN FIBRE PULLEYS

with good quality ball bearing.

1 3/8 diam.	¼ Shaft.	2/6
1¾ diam.	¼ Shaft	3/6
2 3/8in diam.	3/8 Shaft.	4/6
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Add postage.

DEITCH BROS.

70 OXFORD STREET, SYDNEY

BETWEEN CROWN AND RILEY STREETS. CITY

THE SERVICEMAN WHO TELLS

(Continued from Page 63)

I proceeded to relate the two cases I have just described, adding that it would be extremely interesting if a third type of fault was discovered. He replied by suggesting that I give him a hand with the job and thus see for myself.

When we were ushered into the customer's lounge-room, he explained that the trouble, although still in evidence, was not quite so bad now because he had learned to use "these two" controls properly. "These two" controls turned out to be the volume and tone controls and the customer then demonstrated what he meant.

CONFUSED FUNCTIONS

It seemed that he had confused the two functions and had been trying to control the volume with the tone control, setting the latter right down in the deepest bass position (which was pretty drastic). Then, in order to restore some of the intelligibility, he would advance the volume control until the audio system was beefing out bass notes at something like maximum capacity. (Yes, this is fair dinkum!)

However, he informed us rather proudly, he had now learned to use these two controls properly and the trouble was much less evident. This wasn't surprising, regardless of whether the trouble was electrical or mechanical, since the amount of audio power involved was considerable and quite likely to show up any such weak point.

I was inclined to suspect the audio decoupling bypass, as in my own case. The fault certainly wasn't similar to the microphonic line oscillator valve, being a true bar caused by a variation in density, rather than a line displacement effect.

This seemed to be confirmed when my colleague made a preliminary check by gently tapping various parts of the chassis with the butt end of a screwdriver, a procedure which seemed to have little effect. It looked as though we would have to get at the "innards" of the thing.

We pulled the set out of the cabinet, turned it upside down on the lounge-room floor (suitably protected), and traced out the audio HT line. It wasn't possible to make an on-the-spot check, because the picture tube was mounted separately in the cabinet. So we had to solder a new electro into place and put the chassis back in the cabinet for a trial.

After all that, it was rather disappointing to find that, if there was any improvement, it was so slight as to be of no value. This seemed to suggest that there might be a microphonic valve somewhere, after all, in spite of our previous observations.

Accordingly my colleague went over the chassis again, tapping gently while I watched the screen. We eventually decided that there was some response in the vicinity of the tuner, though it was difficult to reach this section properly while the chassis was in a working position.

However, working on this lead, my colleague decided to try a new converter valve and, if that was no help, an RF valve. It must have been his lucky day, because the trouble had virtually vanished when we switched it on again, even under extreme conditions of sound level.

SIMPLE EXPLANATION

Once having found the fault, the explanation became fairly simple. Apparently the converter valve was sufficiently microphonic to allow it to be appreciably detuned by the speaker vibration. The resultant change in frequency, apparently toward the sound signal, allowed the same bars to appear as would have been evident by deliberate mistuning.

After we had taken our leave of the customer and were once again in the ruck, I suggested that future faults of this kind might be more easily identified by temporarily disabling the speaker and noting whether the trouble was removed. If so, it would suggest a mechanical fault, while its continued presence would suggest unwanted electrical coupling.

I'll admit it would have been a lot smarter if I had thought of that one before we tackled the set, but I'm afraid one can't always be one jump ahead.

Well, not with TV, anyway.

FAR SIDE ROCKET RISES 4,000 MILES

(Continued from Page 5)

was the largest ever launched. When fully inflated with helium it had a volume of 3¾ million cubic feet and weighed 1,500lb. The gross weight of the balloon and equipment — almost two tons — represented the heaviest load ever carried to the altitude that was reached.

The launching occurred at 8.0 a.m., on June 28, preceded by days of extensive preparation. The balloon, after reaching an altitude of 65,000ft over Hammond, Wisconsin, approximately 40 miles east of the launching site, continued to ascend to 106,000ft while moving in a westerly direction.

The flight terminated on schedule 5½ hours after launching, when the equipment was automatically released from the balloon and parachuted to the ground near Buffalo, Minnesota. All of the equipment used in the experiment was successfully recovered.

During the flight, equipment carried by the balloon transmitted to ground receiving stations scientific data on atmospheric environmental conditions of a type never before recorded. Camera equipment in the balloon photographed the flight and recorded important information on high-altitude balloon behaviour.

Flight test operations at the Pacific Proving Ground were planned to start during the latter part of September, this year. These tests involve a total of six flights. The flight test crew includes aeronautic engineers and scientists, balloon launching and handling experts from General Mills, and Air Force officers and scientists. Documentation and, to the extent possible, optical telemetering of the flight tests was covered by the Air Force's photographic centre, Lookout Mt. Laboratories.

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Send them by post if you are away from Sydney.

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Australia's leading retailers of ex-Govt. Technical Equipment and other useful articles, have many fine bargains for keen buyers.

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Big Purchase of Brand New Stocks

240-volt Primary
395—volt—395 Volt
5-volt; 6.3 volt C.T

PRICE: 55/-

Packing and delivery to railhead, 5/

RADIO VALVES

No need to pay high prices for replacements if you see our large low-priced lots

SPECIAL PRICES FOR QUANTITIES

6D8	8/11	7W7	5/-
6Q5	8/11	807	19/6
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6C5	7/6	12SR7	7/11
6H6	3/11	1626	5/-
6J5	12/6	1629	7/6
6K7	6/11	AV11	5/-
6K8	10/6	CV.66	15/-
6N7	12/-	EF.50	3/6
6N7	7/6	VR.65A	2/6
6U7	9/9	VR.78	7/6
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6Y6	12/6	VCR.112	50/-
7A6	5/-	3AP1	60/-
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Diameter, 2½in; face, 1½in, hole, 7-8in

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SET NO. 108, 2.5 to 3.5 Mcs
Operates on two 1½-volt and two 45-volt batteries.
Long aerial or rod for portable operation

Price (less batteries)
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Dimmer Switch, 7/6. Magneto Switch, 4-bank, 12/6; 3-bank 7/6. 3-position switch, 7/6.

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1¼in sq. Range 0-100 70/
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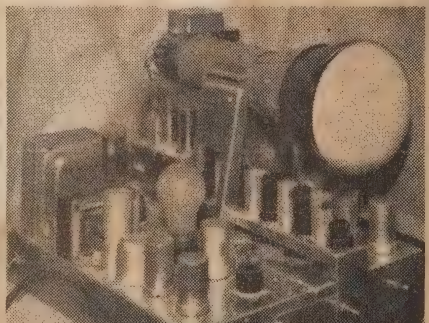
This TV Set built with Waltham Components



Various components bought at Waltham Trading Co were used in the construction of the TV set, illustrated at left.

It was built by Mr. R. G. Taylor of Smith Street, Carrum. He has included the following valves: Three 6AC7 three 6H6, eight EF50, one 6N7; also one Germanium Diode as DC restorer

We have all these valves available

GERMANIUM DIODES

Ideal for Crystal Sets and can be used in TV sets

PRICE 7/6 (post free)

WATCHMAKERS' EYEGLASSES. Extra strong, 10 magnification, 15/-. Watchmakers' Screwdrivers, 13/9.

Packing and Postage, 2/-

INSPECTION MIRRORS. Useful for dentists, radio mechanics, motor mechanics. 8/6.

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PRISMS. Tank Periscope Prisms, 3¼in x 3¼in. 5/.

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We have this in many sizes. This strong metal alloy tubing can be used for many purposes, including TV aerials and masts and many other uses Details:

Diameter	Gauge	Price per foot
5/8in	16	1/3
7/8in	16	1/9
1in	18	2/-
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9/16in	22	1/-
¼in.	16	9d
5/16in	16	1/-
3/8in	16	1/-
7/16in	16	1/-
¾in	16	1/9
7/8in.	16	1/9
3/8in.	17	1/-
9/16in.	17	1/3
¾in	17	1/9
7/16in	18	1/-
7/8in.	18	1/3
¾in.	18	1/6
5/8in.	16	1/3
1in.	20	1/9

(No mail order for Dural Tubing)

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No. 605: 7½in long, 1½in wide. In cardboard case . . . . . 55/ EACH

No. 450: 6in x 1in. Fitted with magnifying cursor. In leather pocket case. PRICE 50/ EACH

No. 403: 4½in x 1in. Fitted with magnifying cursor. In leather pocket case. PRICE 39/6 EACH

No. 28: (Circular type). Diameter, 3in. In plastic cover. PRICE 25/- EACH. Packing and postage, 2/-.

These Slide Rules are complete with Instruction Manual.

ANSWERS TO CORRESPONDENTS

S.J.O. (Kootingal, N.S.W.) is troubled by noises in the headphones of his crystal receiver when a refrigerator starts. Light switches in the house also cause the same trouble.

A. It would appear that there is coupling between the aerial for your crystal set and the wiring of the house. You may improve matters by putting the aerial somewhere else, otherwise some form of filtering in the house wiring would be necessary. The latter would involve quite a deal of trouble and expense and probably would not be worth while. Of course, if the interference is very bad it may show up in other sets in the house and even in neighbouring sets when it may be necessary to use some form of filtering.

T.S. (Tatura, Vic.) includes the circuit of a battery charger using a chemical rectifier, which he thinks may be of interest for the "Reader Built" page.

A. Many thanks for your letter and we will keep it in mind as you suggest.

T.O.G.M. (Melbourne, Vic.) has a query regarding the operation of the Radio Alemeter described in our Answer Tom feature for September. T.O.G.M. is at a loss to understand the difference in carrier frequency between the outgoing signal and the reflected signal.

A. The change in carrier frequency does not occur, as you suppose, by reason of the reflection, but due to a cyclic frequency modulation of the carrier. If there are two signals reaching the aerial, an outgoing and a reflected, there must be a difference in their frequencies by reason of the time lag between them. This action is easy to follow if we assume that the carrier frequency is not fixed, but is being constantly swept over a narrow band, as stated in the article.

R. O'L. (Oxley, Qld.) forwarded a feature, "Here's Your Answer" We will make use of your letter at the first opportunity.

T.H. (Hawthorn, Vic.) would like to build a tape recorder and asks if we can supply a circuit.

A. Yes. T.H. a description and a circuit for such an amplifier appeared in the March, 1953, issue. Unfortunately the complete issue is no longer available, but we can supply a copy of the circuit and other details via the 2/ query service. We have little to offer, however, in the way of constructional information on tape decks or cabinets.

J.R. (Bondi Junction, N.S.W.) would like to be able to describe a converter or converters to tune in the earth satellite on 40 Mc/s and also for the American satellite later on 108 Mc/s. He says: "It has been very easy for me to sit down and write this letter, but it is on you and the stuff the burden will fall. This, however, is a worthwhile project. I'm sure. What do you think?

A. We doubt if sufficient readers would be interested and there are other problems. How many readers would have frequency measuring equipment sufficiently accurate to enable the receiver to be set up exactly on frequency? The selectivity of the IF channel of a receiver likely to be used with such a converter may not be sufficient to separate the required signal from other strong signals nearby. What do other readers think?

W.L. (Oakleigh, Vic.) would like winding data for ½in diam. coils for the recent shortwave converter rather than for ¾in diam. as originally described.

A. Sorry, W.L., but we simply cannot spare the time to sit down and work out this information for you much as we would like to help you. However, as a general guide, we suggest you increase the numbers of turns on all windings by 30 p.c. The overall selectivity is determined

F.L. (Glen Iris, Vic.) has built the "Minivox" receiver from the December, 1947, issue. However, he has left out the reaction coil and finds that he needs an outside aerial.

A. Mainly by the characteristics of the IF channel of the receiver used with the converter, and any improvement would have to be made at this end. The "coil wire" you mention may be special "litz" wire. If so you could find its dimensions from one of the standard handbooks.

A. We wonder that reception is satisfactory even with the outside aerial. A smoothly operating reaction circuit makes an enormous difference to both gain and selectivity and would probably make the set more satisfactory even than the addition of an extra valve. The howl and noise when the potentiometer control is advanced is audio feedback, probably due to poor layout. Make sure that the components associated with the grid circuit of the 6SJ7 are isolated from the plate circuitry and also the plate circuitry of the 6V6-GT. It is a normal characteristic of pentodes for the gain to fall off sharply when the screen voltage exceeds a certain critical value. Normally the reaction coil is adjusted so that oscillaltion occurs with the screen voltage adjusted for optimum audio gain.

T.W. (Herne Bay, N.S.W.) is anxious to secure some books on the subject of circuit diagrams. He finds these rather puzling.

A. Almost any elementary textbook will cover this subject, T.W., and we suggest you visit the technical department of some of the large bookstalls in Sydney ad examine what is available. There is also a pamphlet of circuit symbols available through our query service if you care to write for it.

J.K. (Nunawading, Vic.) asks whether our present 5-inch television receiver could be modified to use 9-inch magnetic tubes currently being advertised.

A. The modifications would be quite extensive and would involve the use of a standard deflection yoke, along with some of the techniques used in other magnetically deflected television receivers. We may have something to say along these lines later, but you can rest assured that the changes would be far from minor.

M.G. (Coburg, Vic.) sends in a number of suggestions and ideas for "Reader Built It."

A. Thanks for your letter, which has been filed for possible use in the appropriate section. We cannot indicate, at this stage, just when the material is likely to appear.

L.H. (Hawthorn, Vic.) wants to know the difference between two valves branded respectively 6X5GT and 6X5GT/G.

A. Electrically the two valves are identical The purpose of the "/G" part is merely to emphasise that the valve is also a replacement for the older 6X5G, which is identical electrically but housed in a larger, domed glass envelope.

H.V.S. (Brighton, Vic.) is anxious sound tracks some information regarding ma on sub-standard film, presented any constructional

A. We ha these lines. H.V.S., though we have recorded a number of tape recording and playback amplifiers, which may be adaptable for this kind of work. Circuits, etc., are available through our postal service in the usual way. If available, we would refer you to the July, 1953, issue, page 23, and September, 1955, page 21. The number of frames per second used is not important except in so far as it affects the film speed, and a speed of 4.8 in/sec is capable of giving very good results.

R.E. (Auckland, N.Z.) wants to know if there is any commercial unit available to provide remote tuning of a receiver.

A. Devices like these were quite popular at one time, R.E., but are not seen much these days. Their main weakness seems to be the difficulty of keeping so many pre-set circuits in tune, and this leads to a lot of trouble unless some form of automatic frequency control is used. However, you may care to refer to the September, 1949, issue, Reader Built It section, wherein is described a Set For The Lazy Listener. We have no copies of the magazine, but can let you have a copy of the circuit through the postal service.

A.B. (Unley Park, S.A.) has an old-time set which distorts badly when the volume control is advanced and he wants to know the cause of this. He suggests that it might be some form of overload.

A. Yes, A.B., it is almost certain that this effect is due to overload, though the exact cause may not be so easy to establish without an examination of the chassis. In these old sets the volume control was a variable bias control in the IF amplifier (58), and it is often difficult to obtain enough range of control to take care of all possible signal levels. Some improvement was effected by coupling the aerial terminal to the volume control so that the aerial circuit was progressively shorted out as the bias was increased. However, too large an aerial and a powerful, local signal could still overload the system. If, in addition, the 58 valve is low in emission it will overload at lower values of bias, further restricting the range of control. This subject was covered in some detail in one of the Serviceman's recent articles, and we suggest you study this for a more detailed explanation than is possible here.

B.S.C. (Blackwater, Q'ld.) is over 100 miles from his nearest transmitters and has trouble receiving them at night, due to interference from adjacent channels. He also wants to know if it is possible to operate his set from a 12-volt dry battery and vibrator supply.

A. Your trouble is essentially one of insufficient selectivity and is not unusual in locations such as yours. The variable nature of the interference is, as you say, due to the varying height of the reflecting layer, which causes the strength of the interfering signal to vary. Modifications to the aerial are not likely to help, again for the reasons you suggest. Any of the methods you suggest should result in increased selectivity, though there is always a risk that extra stages will introduce the complication of instability unless the overall gain is carefully controlled. In other words, it is only increased selectivity that is required, not increased gain. Assuming sufficient order of selectivity it should be possible to eliminate the adjacent channel signals, but there is also the possibility that the stations you want may be sharing channels with other stations, in which case there is little that can be done to reject them.

We doubt whether the operation of your set from a dry battery/vibrator combination would be successful, as there is inevitably some loss of energy in these systems. It may thus prove more expensive than running the set direct from conventional batteries.

L.S.P. (Mt. Lawley, W.A.) wants to build the Wide-Band Tuner, but is having difficulty in securing the bandpass coil. He wants to know if a conventional RF coil can be used, ignoring the primary winding.

A. We are rather surprised that you cannot obtain this coil L.S.P., and we suggest that you contact some of our advertisers, particularly those specialising in kit sets, who should be able to help you. Alternatively, there should be no objection to using the RF coil, though we suggest that the primary coil be shorted out, or even removed altogether.

The Radio, Television and Hobbies Query Service

All queries concerning our designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

Note that we do not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

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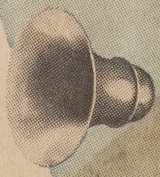
Polished timber cabinet for wall or table mounting with 12" cone speaker and 600 ohm line transformer.

PA150/W

Moulded wall speaker, similar to above. These models are also available with 600 ohm stepped faders.

RESLO DRIVE UNITS: SU10 & SU12

Exclusive features are the self-locating diaphragm and the concentrically interlocked magnet which together produce an undisplaceable mechanical assembly, proof against de-centering.



PA108 & PA109

These flare baffles are for use with 7in and 12in permanent magnet cone speaker units and provide high conversion efficiency.

PA118

Pendant type, ceiling suspension, 360° diffusion speaker suitable for distribution of voice and music.

PA73

Ivory timber cabinet with 7in speaker for applications where a bi-directional characteristic is desired.

PA143

Short exponential horn speaker for distance projection of speech only.

PA177

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A CLIPPER-FILTER FOR AMPLIFIERS

(Continued from page 55.)

a pi section terminated at either a half-section m-derived filter. n arrangement really works well involves three inductors.

taking some liberties with the filter theory we were able to ve excellent characteristics with only inductors. As with all filters, both capacitor and inductor values are critical.

e chokes can be wound from the given and it is possible to get nably close to the original values ve proved by winding a couple of icate sets. However, if you win own chokes, we suggest that you k the performance of the finished by some means. Accurate induc- for the filter are available through trade from Brameo.

here should not be too much diffi- y in obtaining reasonably accurate actors especially as these items are tively easy to measure. Some vari- n in characteristic curves of indivi- l units are inevitable but we suggest the final curve at the high frequency should not vary more than about from the published version. This lies particularly to the region near Kc/s. Peaks before the fall-off ld accentuate the tendency to ring, ch is a characteristic of all sharp cut- filters.

The placement of the chokes is not ical but they should not be closer n about 3 or 4 inches from a power sformer and should not be mounted xially close together. Normally hum kup will be negligible.

n conclusion a few remarks on the ctical operation of the unit may be preciated.

The setting of the 25,000 ohm pot in output circuit should be made with aid of a CRO in the case of an AM nsmitter. The trapazoid pattern is t for noting the exact point at which 0 p.c. modulation occurs.

The signal at the modulator output will ershoot the normal clipping level due phase changes in the system after clip- g and, therefore, the control should set so that just under 100 p.c. modu- ion is reached under normal speech nditions.

If the clipper high tension is taken m a class B modulator supply where regulation is imperfect, a setting for 0 p.c. modulation on speech will re- t in less than 100 p.c. modulation a steady tone due to the clipper erence voltage changing. If there is y choice in the matter it is best to d the clipper from a well-regulated urce.

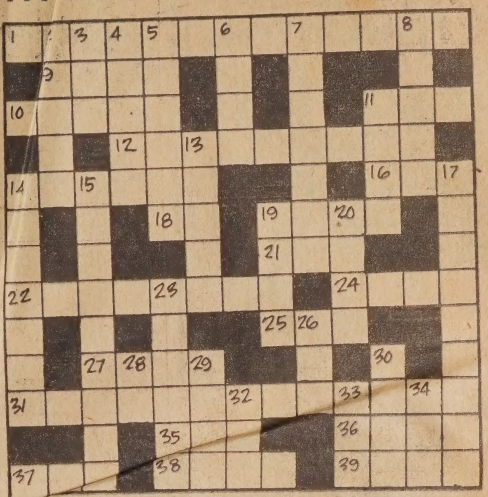
A microphone with a peak in the AGC aracteristic will render the AGC less ective since the peak tends to take con- l. You can obtain reasonable results turning the gain down. There is no y substitute for a good microphone, ner with or without the new speech amp. and clipper system.

If the mic. peak is around about 2.5 /s or higher good results can be ob- ned by placing a bypass capacitor at plate of the mic. preamp. larger n the 100 pF shown. The value would e to be determined by experiment. With the first gain control full on and 20 mV rms input, clipping will be about 5 db varying to about 8 db with 100 mV input and up to, say, 12 db under close talking conditions. However, the average should be about 6 db when the increase in level is very noticeable with negligible distortion.

If your microphone has a higher output, the gain control will need to be turned down to obtain the same results. The maximum position of the control should be that which results in obvious distortion under very close talking conditions, an indication of heavy clipping and an excellent setting for working under difficult conditions. For normal contacts you can talk a foot or two away from the microphone.

Without exception amateurs who have heard the new unit on the air have remarked on the excellent overall quality and at the same time the obviously full modulation. Personally, we do not think that we will ever build another modulator for our own use without a similar system.

THER., T.V. & H. CROSSWORD No. 43



ACROSS

1. Isolating inductor in regenerative detector plate circuit (2 words).
9. Stringed musical instrument.
10. Covers with wax.
11. Employment of method.
12. Present era (2 words).
14. Organ of a flower producing pollen.
16. Finish.
18. Drill instructor (abbrev.).
19. Ceases to live.
21. Past tense of eat.
22. Resistance wires in an electric heater.
24. Game of chance.
25. A tense of the verb to have.
27. Very (French).
31. Technical journalist.
35. Dark resinous substance.
36. To satisfy the appetite of.
37. Bulky piece of timber.
38. To break short.
39. One time married to Shirley Temple.

DOWN

2. To appoint by vote.
3. Town in Queensland.
4. Rises to the surface of milk.
5. Tried.
6. Female reproductive cell.
7. A graphical representation of radio equipment.
8. Girl's name.
11. Periods of time.
13. Bulbous plant used for food.
14. Chooses.
15. Bringing to a stand.
17. A device for restoring an early detector to its operating condition.
19. To make haste.
20. Snake - like fishes.
23. Incidents.
26. The atmosphere.
28. Royal Engineers (abbrev.).
29. Action of a beam of light in TV.
30. A male red deer.
32. A historic period.
33. Mountain in Queensland.
34. Seventh letter of Greek alphabet.

Solution and further crossword next month

Last month's solution

P	R	I	M	A	R	Y		C	H	O	K	E
E		N	T				O		P			T
R	A	D	I	O	A	C	T	I	V	E		H
M		U	N	M	O	R	A	L		N	E	E
E		C		R	E	P		T				R
A	R	T	S		T	A		L	E	F	T	
N	A	I	L		A	M	N	E	S	I	A	
C	R	O	U	P				S	T	R	I	P
E	I	N	S	T	E	I	N		I		L	
	T		H	O	M	E		S	N	E	E	R
T	I	P		M		N	E	G		N		
R	E	A	C	T	A	N	C	E		D		
I	S	M				O	P	P	O	S	E	

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ANSWERS TO CORRESPONDE

D.K. (Lutwyche) recently had o[n] vice a Control Unit and was [a]pparently low voltages on the EF86's. He suggests that we shou[ld] voltages in our circuit diagrams to avoid such problems.

A. The apparently low plate vol[t]ance coupled stages are a regular [f]eature in fusion for beginners D.K., although a subject quite frequently in varti[ous] articles. In fact, these voltages are [not] they seem, since they are invari[ably] with a conventional 1,000 ohm-p[er]-which can easily draw as much [as] the stage itself, or even more. In [some] stances the drop across the plate resis[tor] higher than under working conditi[ons] voltage indicated is of limited valu[e] that a knowledge of the voltage [at] these positions would help, but, as [you] preciate, it would also be necessa[ry] whether we can help him diagnose [the] old receiver he is trying to get worki[ng].

A. The "henry" B.T. is the unit o[f] the property possessed by all conduc[tors] especially by coils. The exact definit[ion] lengthy and hardly suitable for a pre[sent] but we may cover the subject in g[ood] the "Answer Tom" page at a later [date] are afraid we cannot help you ver[y] matter of the set, this kind of fault [is] during an examination of the cha[ssis] to track it down. We suggest that s[ome] little more experience than you [have] to help you out particularly if [no] gear is available.

P.M. (Mt. Isa, Q'ld.) ask[s] band shortwave converter recent[ly] be used with a 6-volt vibrator ro[tary] A.W. see no especial reason w[hy] accumulator would need to be operated fr[om] would be amiss if the B-plus supply [to] vibrator filtering would be adequ[ate] only an actual test would show. If [it] be faced with a very difficult problem [in] tively one that could be solved with a extra bypass capacitors. By deliberate[ly] ing coupling between the plate an[d] IF amplifier, it may be possible to [the] stage oscillate and thus render C[W] audible. Reports re the signal from [you] have varied widely. Our best he[ard] signal was not substantially unmodulat[ed] essentially a triggered CW signal. M[any] who, allegedly heard modulated sig[nals] may well have heard beats between [ad]jacent transmitters. In fact, the frequenc[ies] so crowded with these shortwave sig[nals] there was no guarantee that signals [you] heard were actually from the satellite.

P.K. (Sans Souci, N.S.W.) wants [to] whether he should tackle the 5-inch TV[set] cently described. He describes himself as no previous radio experience whatsoeve[r] also wants to know if this is the best [to] commence a radio career.

A. we think it would be very unwis[e] beginner such as yourself to tackle such [a] fect P.K., since these articles all assu[me] fair basic knowledge of the subject. I respects the 17-inch version would be m[ore] able (though much more expensive) sh[ould] is no judgment necessary in the selection o[f] However, even here, we definitely do not mend such a project to the absolute b[e]. We have described many simple amplifi[ers] fects in the past, including some for guitars, and copies of these are available [from] our postal service.

If you intend to leave school after the mediate we would suggest that an appr[en]ship—if you can secure one—would be [the] scheme. This would automatically involve a trade course at the technical college natively, any kind of a job in the radio [in] which will ensure your admission to technical college would still be extremely able. The alternative approach is to remain school until the Leaving Certificate is ob[tained] and then take a diploma course. This is a deal harder, and assumes that certain subjects been passed in the Leaving exam. We s[uggest] you consult your nearest vocational guidance cer for more exact details.